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February 1959

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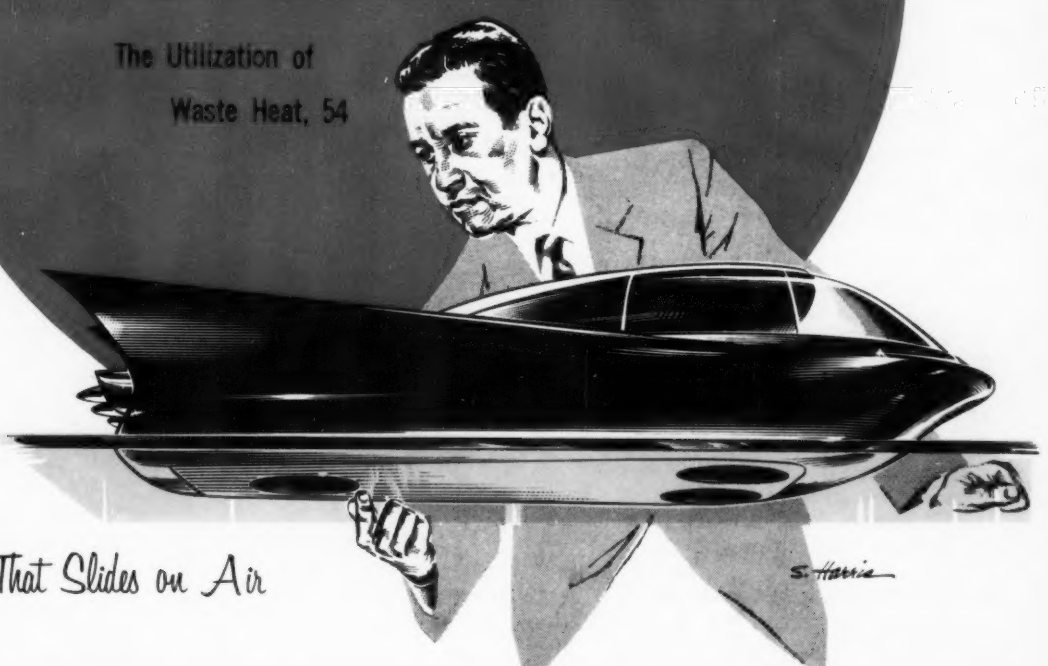
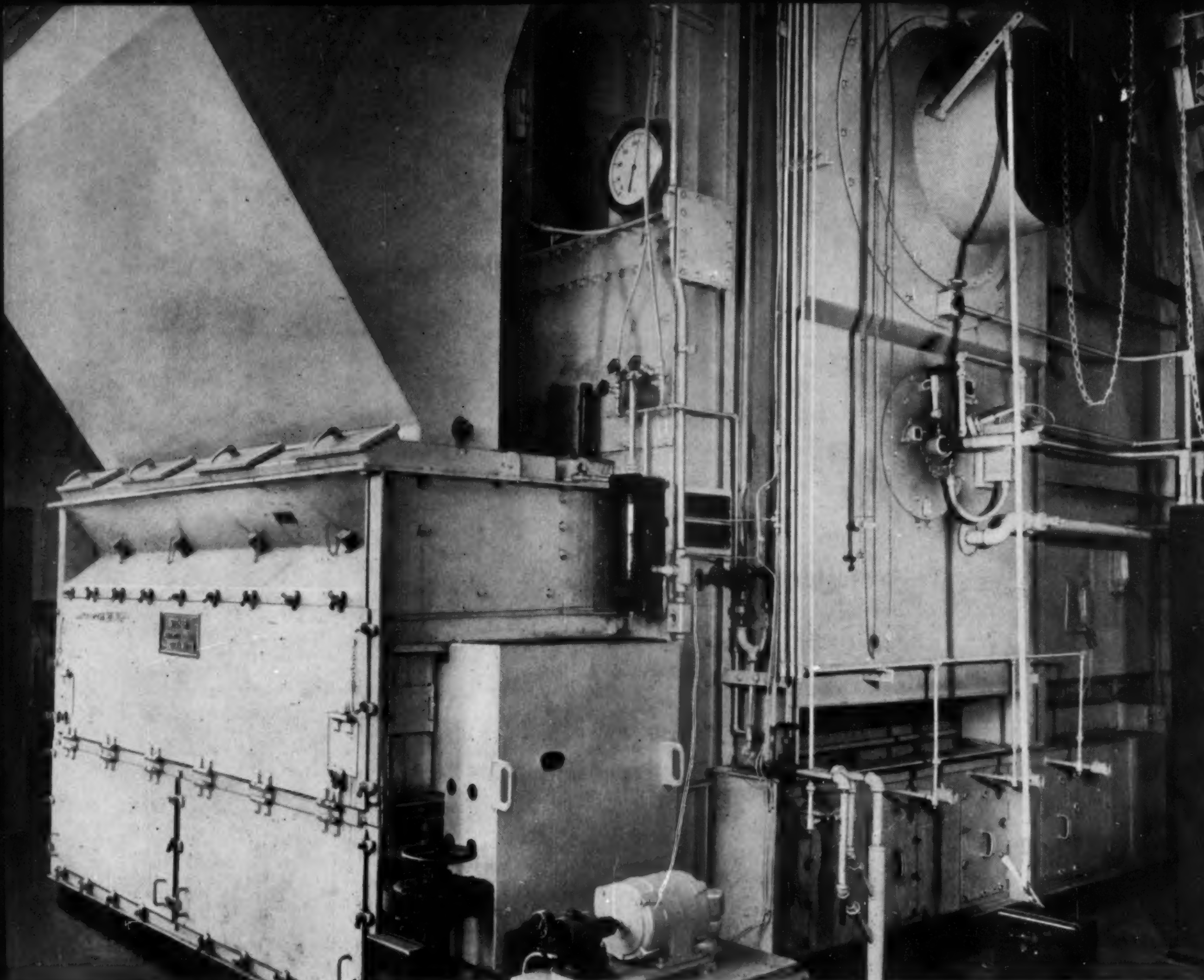


Car That Slides on Air



B&W Integral-Furnace Boiler at Case Institute of Technology, Cleveland, Ohio, has a capacity of 24,000 lb of steam per hr at operating pressure of 225 psi and design pressure of 250 psi. Consulting Engineer: McGeorge-Hargett & Associates, Cleveland. Illustration above shows a view of the stoker in the front wall and gas burner in side wall.

B&W INTEGRAL-FURNACE BOILER PROVES VERSATILITY AT CASE INSTITUTE

Specially Designed Firing System Provides Two Steam Output Ranges

Faced with the problem of heavy steam loads in winter and greatly reduced loads in summer, Case Institute of Technology, Cleveland, Ohio, installed a B&W Integral-Furnace Boiler with a dual firing system.

To answer heavy load requirements during the winter heating season, the boiler is fired by a B&W Jet-Ignition Stoker. Operating as a coal-burning unit, it economically supplies steam for heating, laboratories, and other uses at 6,000 to 24,000 lb of steam per hr. During the light load summer months, boiler-firing switches to a natural gas unit built into the furnace wall. This forced draft burner is fitted with automatic combustion controls for a lower steaming range of 2,000 to 10,000 lb of steam per hr.

Flexibility of operation in this B&W installation is a highly economical answer to the "peak and valley" seasonal demand faced by Case. The two firing arrangements operate completely independent of each other.

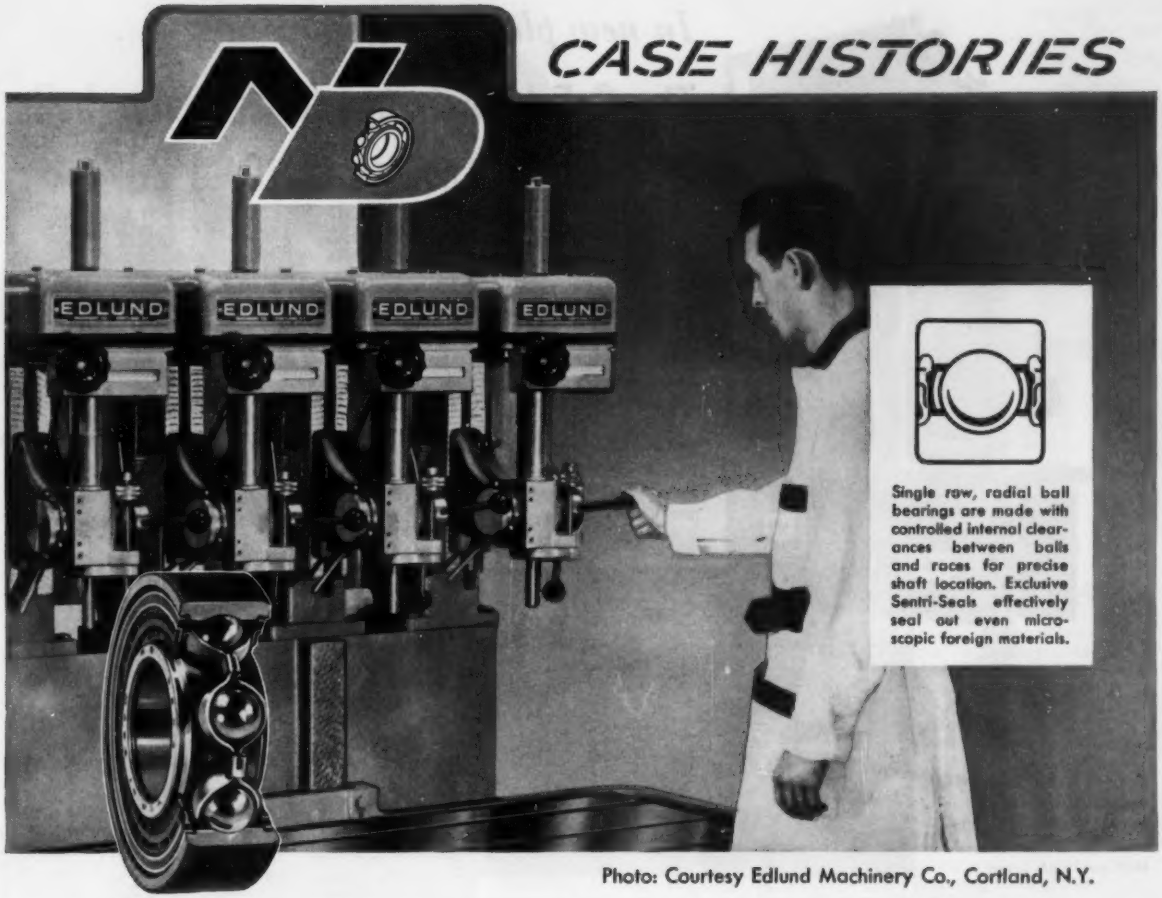
Efficient, trouble-free performance is another reason why B&W Integral-Furnace Boilers are consistently selected by institutions and for commercial and industrial installations throughout the country. Completely integrated units, B&W Boilers are backed by the undivided responsibility of one manufacturer with nearly a century of steam generating experience, and a national network of plants and field engineers. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

G-861-FF

BABCOCK & WILCOX

BOILER DIVISION

CASE HISTORIES



Single row, radial ball bearings are made with controlled internal clearances between balls and races for precise shaft location. Exclusive Sentri-Seals effectively seal out even microscopic foreign materials.

Photo: Courtesy Edlund Machinery Co., Cortland, N.Y.

N/D Ball Bearing Design Adds Efficiency... Cuts Relube Maintenance In Drilling Machine

CUSTOMER PROBLEM:

Tool manufacturer requires minimum maintenance ball bearing design for new high-speed multiple drilling machine.

SOLUTION:

N/D Sales Engineer, cooperating with company engineers, recommended New Departure ball bearings with exclusive Sentri-Seals in place of conventional open bearings. These ball bearings, sealed and lubricated for life, virtually eliminated bearing relubrication maintenance. In addition, these sealed bearings accounted for a savings in parts and assembly time by eliminating costly lubrication plumbing and fittings. What's more, the application has proved so successful, the customer has had other types of drilling machines redesigned to use New Departures.

If you're working on new machine designs, why not call on New Departure? There's probably an N/D *production* ball bearing that will help you, and, at a lower cost! For more information write Department U-2.

Replacement ball bearings available through United Motors System and its Independent Bearing Distributors

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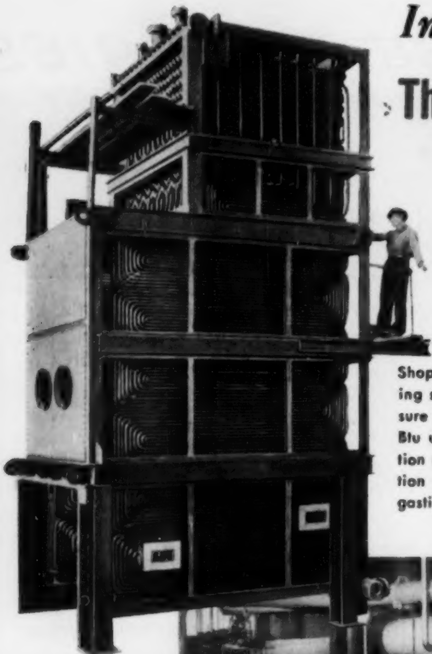
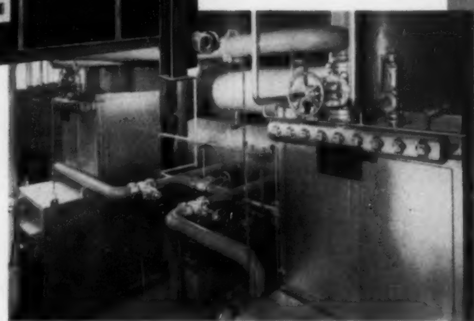


Shop-assembly view showing steel frame and pressure parts for 25-million Btu unit prior to installation of refractory, insulation block, and welded gastight casing.



Compactness of C-E HCC Boilers is demonstrated in this view of two 10-million Btu units installed at a new Michigan high school.

Representative list of C-E HCC Boilers in service, under construction, or on order

	No. of Units	Normal Output ea.—Btu/Hr. (millions)	How Fired
A. E. Smith High School Riverview, Michigan	2	10	Oil
J. Bishop & Co. Malvern, Pa.	1	12	Oil
Colorado State College Greeley, Colo.	1	60	Oil—Nat. Gas
Cross Company, The Frazer, Michigan	2	12	Nat. Gas—Oil—
Defense Construction Ltd Camp Gagetown, N. B., Canada	3	70	Pulv. Coal Gas
Erie Mining Company Aurora, Minn.	2	65	Stokers—Oil or Gas
Convair Astronautics Div. General Dynamics Corp. San Diego, Calif.	2	30	Oil—Nat. Gas
General Motors Overseas Santos, Brazil	1	12	Oil
Hillcrest Medical Center Tulsa, Oklahoma	1	20	Nat. Gas
Marquardt Aircraft Co. Ogden, Utah	2	12	Oil—Nat. Gas
Michigan State University Oakland, Michigan	1	12	Oil—Nat. Gas
New Florida State Prison Raiford, Florida	2	30	Oil—Nat. Gas
North Carolina Wesleyan College Rocky Mount, N. C.	2	18	Oil—Nat. Gas
U. S. Air Force Academy Colorado Springs, Colorado	3 2	100 30	Oil—Nat. Gas
U. S. AIR FORCE:			
Clinton County Air Force Base Wilmington, Ohio	1	16	Stoker
Dover Air Force Base Dover, Delaware	3	50	Oil—(Fut. Coal)
Forbes Air Force Base Topeka, Kansas	3	42	Oil—Nat. Gas (Fut. Coal)
Grand Forks Air Force Base Grand Forks, North Dakota	2	28	Stokers—Oil
McGuire Air Force Base Wrightstown, N. J.	4	80	Stokers
Minot Air Force Base Minot, North Dakota	2	25	Stokers—Oil
Plattsburgh Air Force Base Plattsburgh, N. Y.	2	50	Oil
Portsmouth Air Force Base Portsmouth, N. H.	2	110	Oil—Nat. Gas (Fut. Coal)
Wright-Patterson Air Force Base, Dayton, Ohio	1	[illegible]	Stoker
Wurtsmith Air Force Base Oscoda, Michigan	[illegible]	[illegible]	Stokers
Air Force Base Torrejon, Spain	[illegible]	40	Oil
U. S. Navy Auxiliary Air Station Fallon, Nevada	2	18	Oil

The list at right points up the versatility and widespread acceptance of Combustion Engineering's HCC boiler. For industrials, schools, institutional use, military bases—wherever there is extensive space to be heated—C-E high temperature water has a place.

Featuring the same principle applied by Combustion in many of its large utility boilers, the C-E LaMont Controlled Circulation Hot Water Boiler offers a compact and effective arrangement of heating surfaces. This design gives precision temperature control, and, dependent upon local conditions, the HCC can save 10 to 20 per cent in maintenance and operating costs—a significant factor when considering a heat source.

Available in a wide capacity range—from 10 to 300-million Btu's—these boilers operate at water pressures up to 500 psi and temperatures to 470 F or higher. The smaller capacity HCC's are completely shop-assembled, while the intermediate and large units are shipped in varying stages of assembly. This C-E practice greatly reduces erection costs.

If you are in the market for boilers, either for space heating or process requirements, it may prove greatly to your advantage to investigate C-E high temperature water as your heat source.

Because individual needs vary, *both* steam and hot water have their applications. Combustion Engineering can furnish either, and our engineers are exceptionally qualified to discuss *impartially* with you or your consultants the method most suitable for your situation.

Write for further details on Combustion Engineering's High Temperature Water Boilers.

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MECHANICAL ENGINEERING

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Contents

VOLUME 81 • NUMBER 2 • FEBRUARY, 1959

THE COVER

You ride on air with pneumatic tires, air springs, the wings of a plane. Now under test is a new concept, the Ford "levapad," which replaces the wheel with a jet of air. The picture shows a model of Ford's "Glide-air," a car that will move swiftly over the surface on a film of air only a few thousandths of an inch thick. In developed form, the levapad vehicle—with monorail roadbed—will meet the need for higher speeds on land, extending the practical speed of ground travel into the 200–500 mph range. See page 82.

ASME's RESEARCH COMMITTEE PROGRAM .... E. M. Barber **48**

Just 50 years ago, ASME made its first move to guide and stimulate research. Today, its sponsored research is outstanding among the research programs conducted by major engineering societies.

NSF's BASIC-ENGINEERING RESEARCH PROGRAM .... G. M. Nordby and R. H. Long, Jr. **52**

Suppose there's no immediate application for that research project of yours—and no funds. The National Science Foundation supports projects at the scientific end of the research spectrum.

THE UTILIZATION OF WASTE HEAT .... J. H. Potter **54**

You paid for it: Must it be allowed to escape? Or will the cost of recovery equipment offset savings? Here is today's thinking, and the likely directions, in the engineering of heat recovery.

THE CONVAIR "600" JET TRANSPORT .... J. T. Ready, Jr. **59**

It would travel at near-sonic speeds, at tremendous altitude, in extremes of temperature. It would be comfortable—and, above all, safe. Here's how mechanical engineers met the specifications.

VISCOELASTICITY IN LUBRICATION .... G. J. O'Donnell **63**

This could explain some curious phenomena in machine elements—how a downward curve of load-carrying capacity can reverse itself at still higher speeds, and climb again. Research is indicated.

PROGRESS IN RAILWAY MECHANICAL ENGINEERING 1957–1958 .... D. R. Meier **66**

Envy the men who designed 1958's new trains. Coal-fired turbines, mechanical-drive turbines, hydraulic-drive diesels, diesel-turbine combinations. . .these are the days to be a mechanical engineer.

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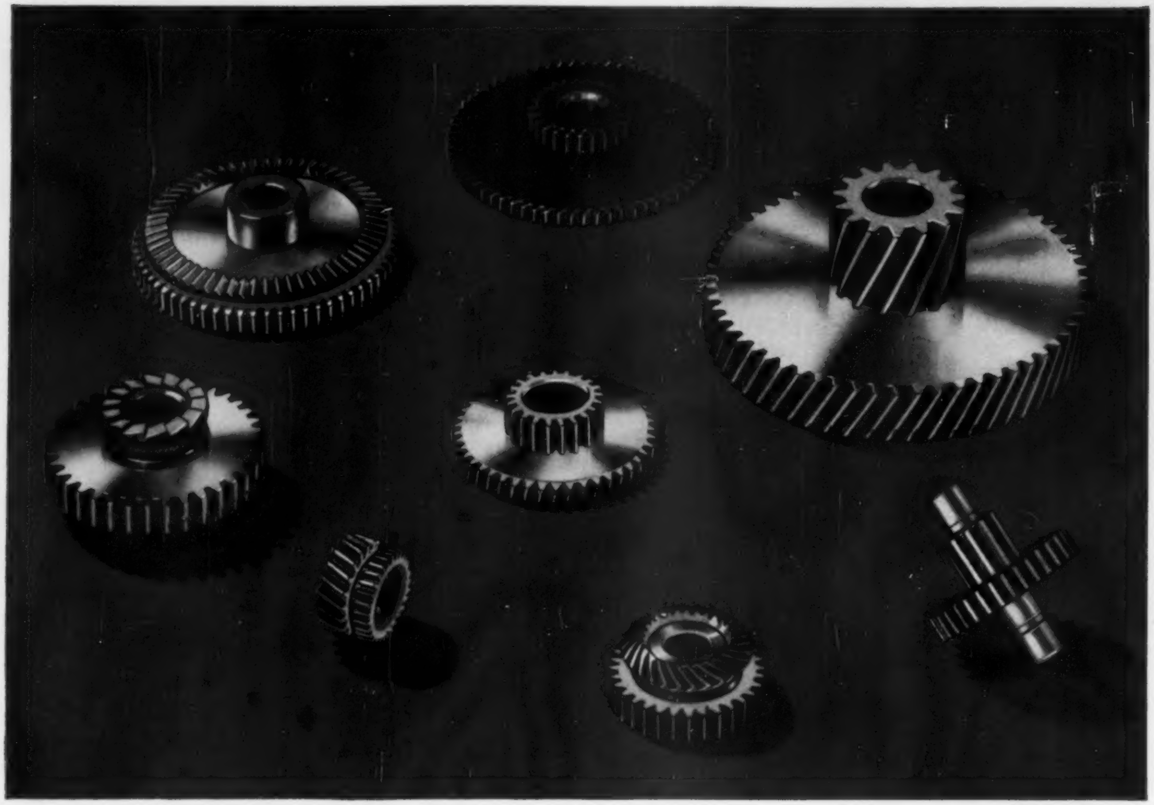

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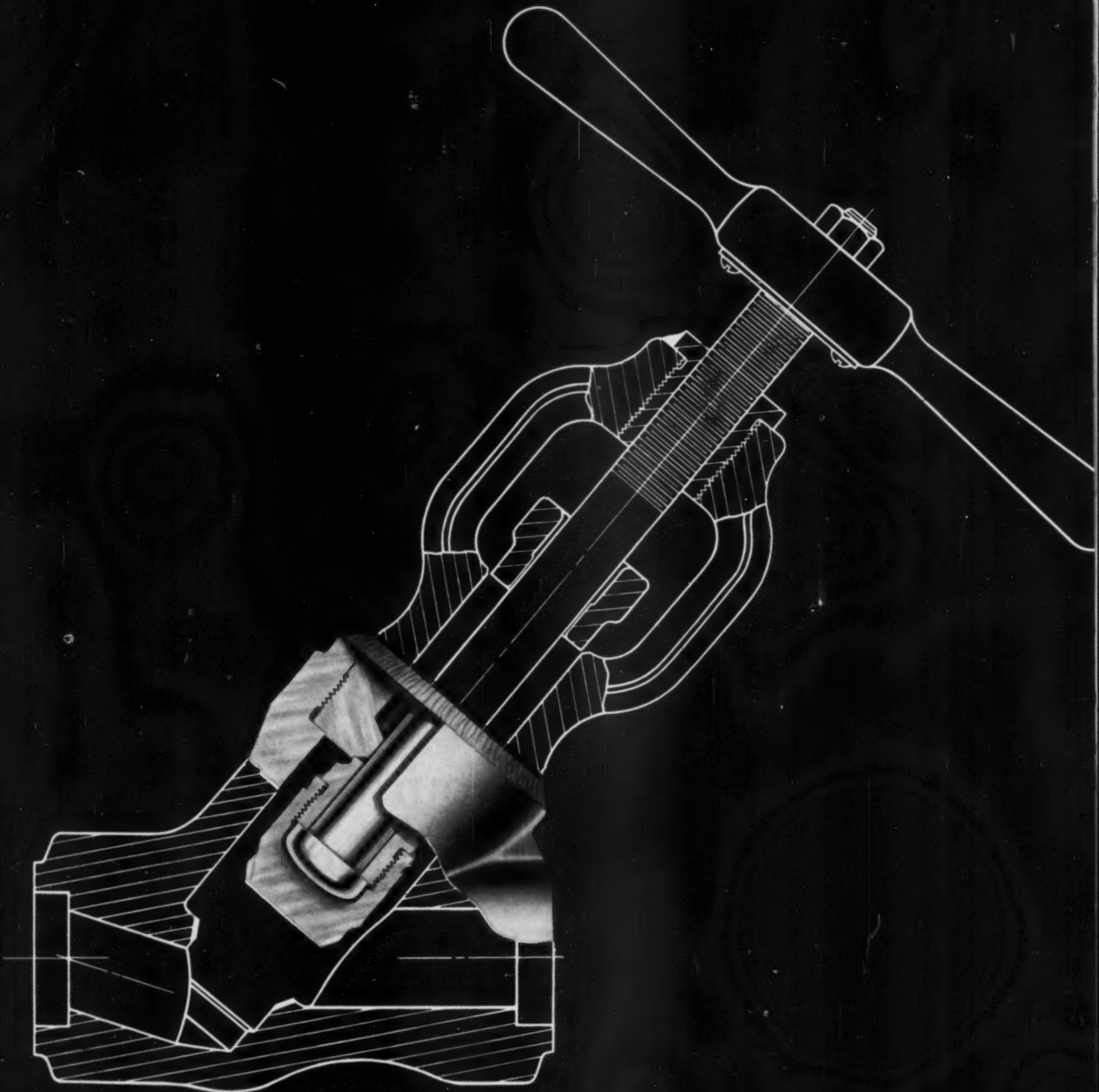

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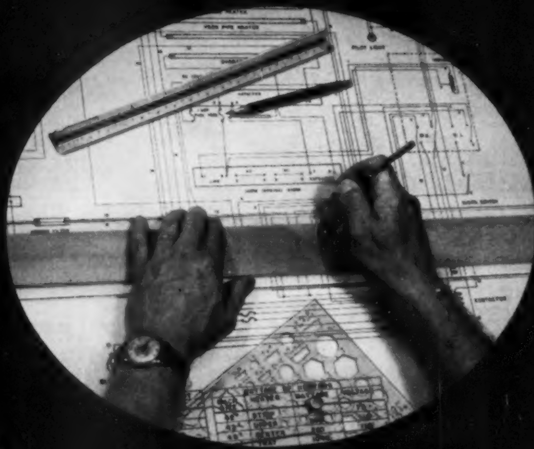

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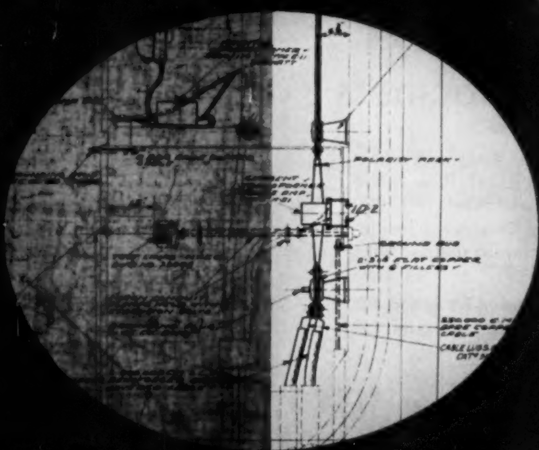

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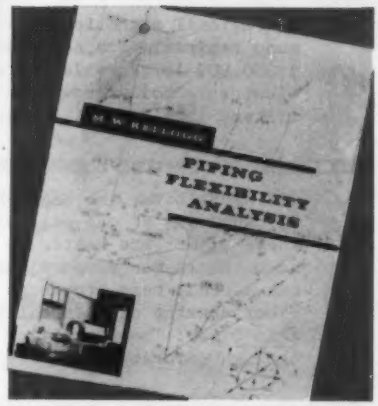
All power piping for the unit is being fabricated and erected by Kellogg, who will also furnish and install all hangers, guides, anchors, supports, and similar equipment. K-Weld®, Kellogg's unique, inert gas-shielded arc welding technique, is being used on the main steam line and hot reheat lines, and was used in fabricating the header shown above.

Dimensions of the critical steam lines being fabricated of 1¼ Cr., ½ Moly. in Kellogg's Jersey City shops are: *Main Steam*—17.5" O.D. x 2.25" minimum wall, and 12.75" O.D. x 1.6875" minimum wall; *Hot Reheat*—26" O.D. x 1.24" minimum wall, and 16" O.D. x 0.8025" minimum wall.

Kellogg welcomes the opportunity to discuss its complete power piping design, fabrication, and erection facilities with consulting engineers, engineers of power generating companies, and manufacturers of boilers, turbines, and allied equipment.



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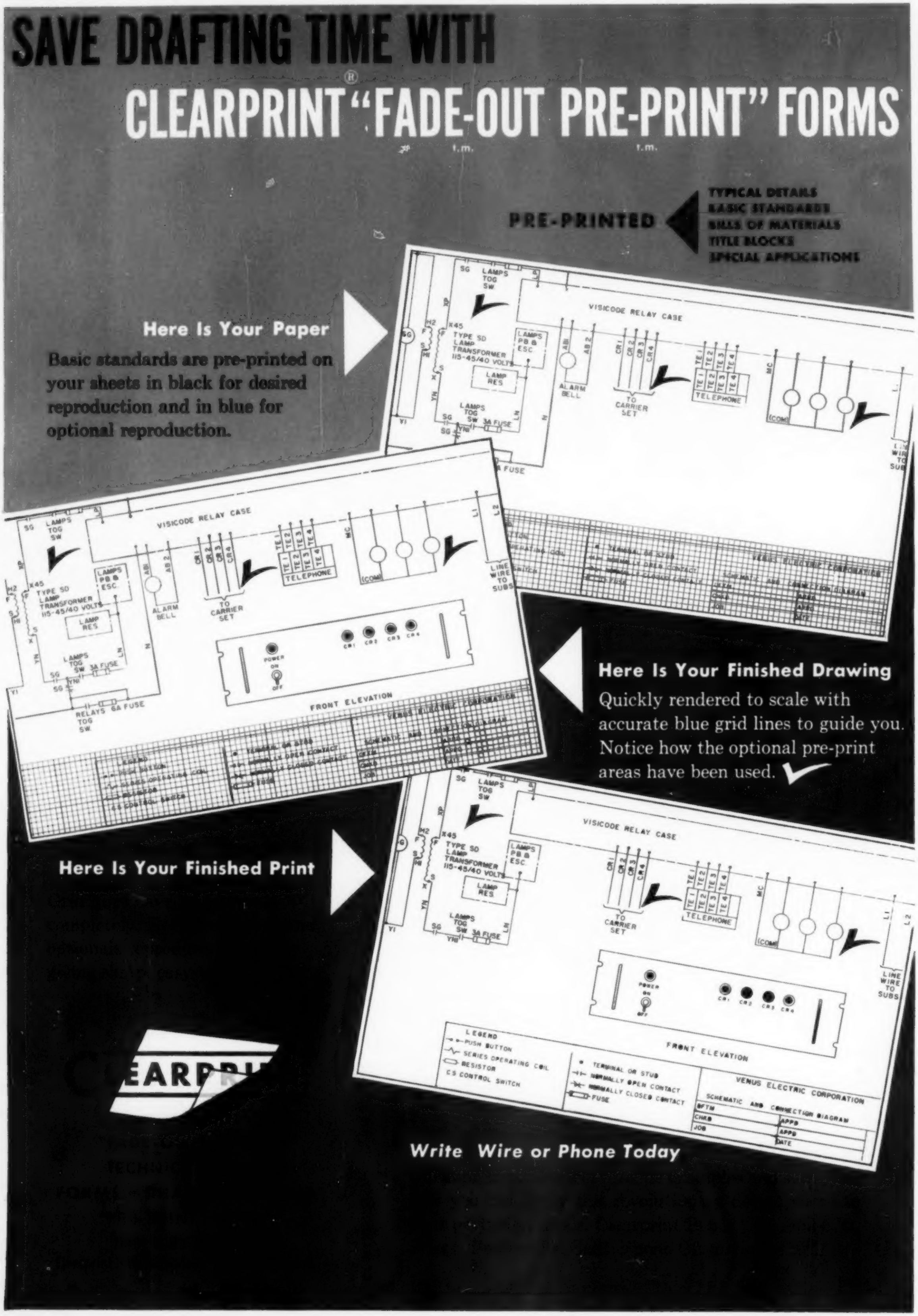
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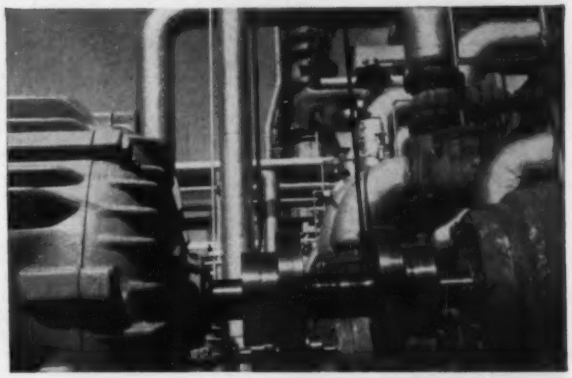
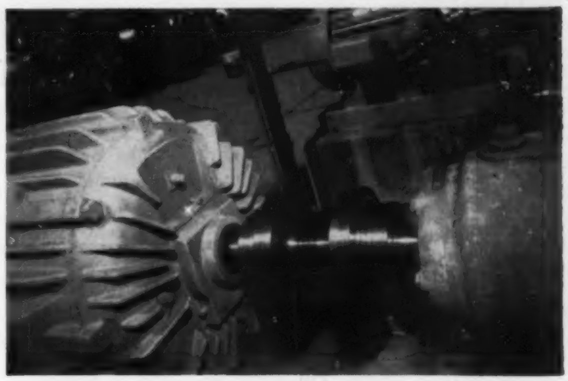
Nearly 40 years of coupling experience qualifies Koppers to solve *your* coupling problem. Write today for full details to: KOPPERS COMPANY, INC., Fast's Coupling Dept., 5702 Scott Street, Baltimore 3, Md.



Fast's Couplings give dependable, trouble-free service throughout Tidewater's entire production facilities.



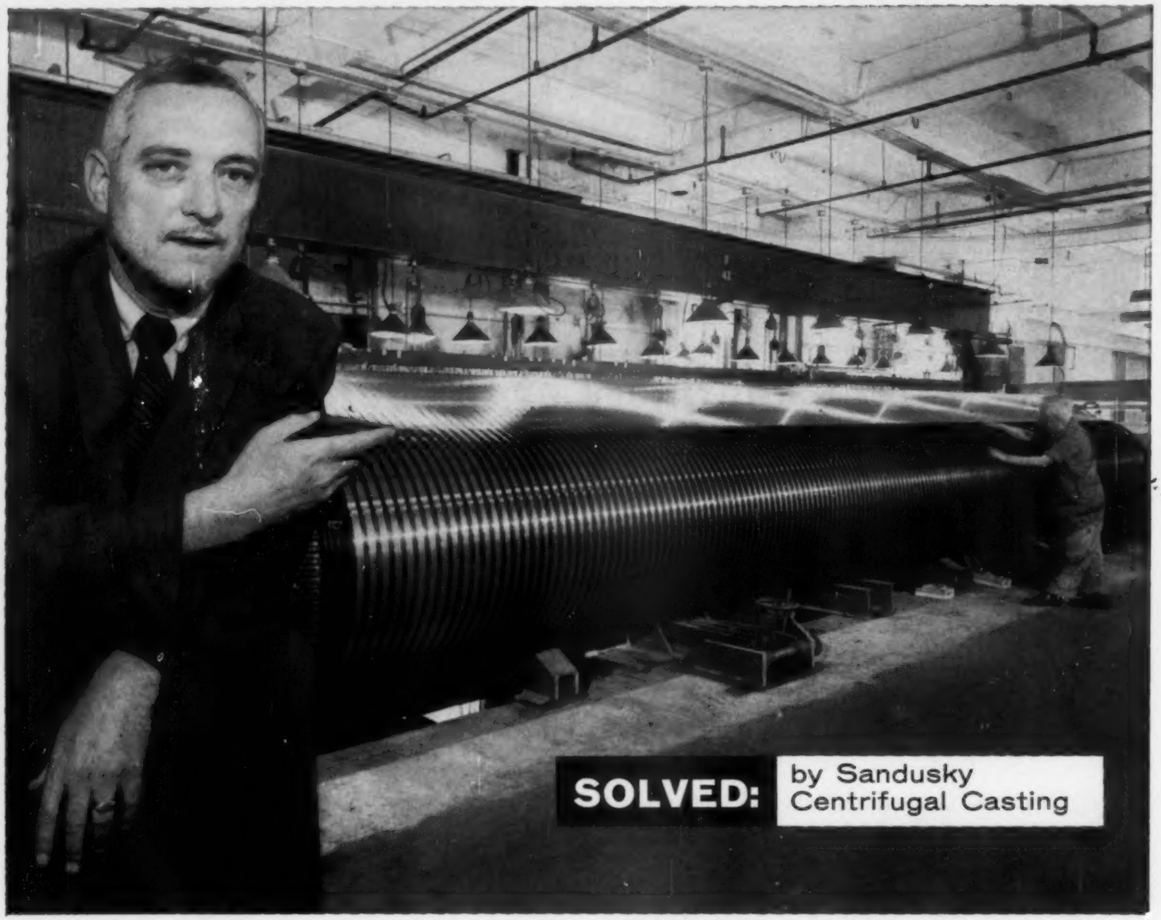
This Fast's Coupling drives a pump delivering heavy naptha to the Solutizing plant.

Engineered Products Sold with *Service*

KOPPERS

THE ORIGINAL

FAST'S Couplings



Eastwood-Nealley's chief engineer points out great size of grooved cylinder

Who else could cast this 22-ton cylinder for the world's biggest wire cloth loom?

To weave Fourdrinier wires up to 352" wide for the world's newest and largest paper machines, Eastwood-Nealley Corp., Belleville, New Jersey, required a cylinder over 30 feet long.

Sandusky supplied this 44,685 lb. roll, centrifugally cast of SAE-1030 steel and rough machined to 363" in length, 40⅝" on the O.D., to be used as the backbeam on Eastwood's new wire cloth loom. Since the cylinder had to be machined with 176 extremely smooth 2" x 2" stirs (grooves) in which wire is wound, it had to be of *flawless quality.* Otherwise any voids or inclusions exposed by machining would nick the delicate bronze strands and cause the expensive wire cloth to fail.

Eastwood-Nealley's chief engineer, Clemson A. Bower, asserts: "*We chose a Sandusky Centrifugal Casting because only Sandusky could make such a gigantic cylinder without welding. We were confident that our special machining operation would be accomplished without costly re-makes, for in the 12 years we have been using them, we never found a single flaw in a Sandusky Centrifugal Casting!*"

When cylinders or piping are needed in your design, keep Sandusky Centrifugal Castings in mind. We can supply cylindrical products from 7" to 54" O.D. and up to 33 feet long—made from a variety of alloys including stainless, carbon and low-alloy steels as well as copper- and nickel-base alloys. Send for free booklet, "Your Solution to Cylindrical Problems."

SANDUSKY **CENTRIFUGAL CASTINGS**

FOUNDRY & MACHINE CO.

5804

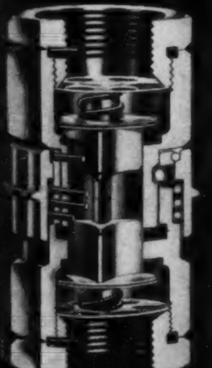
SANDUSKY, OHIO Stainless, Carbon, Low-Alloy Steels—Full Range Copper-Base, Nickel-Base Alloys

Snap-Tite couplings stop the flow instantly"

Snap-Tite provides instant shut-off wherever fluid coupling is needed.

Snap-Tite couplings connect and disconnect quickly and fully—they automatically open line flow when connected; positively seal your line when disconnected—with no "ifs", no chance for human error.

Snap-Tite couplings are available in sizes from 1/4" to 10" ID in all machinable metals. For more information, write for Snap-Tite catalog and, if you wish, describe your problem. Your local Snap-Tite representative will be glad to advise you.



Provided with valves to give two-way or one-way automatic line shut off.

Built to handle high pressure in hydraulic and air systems.

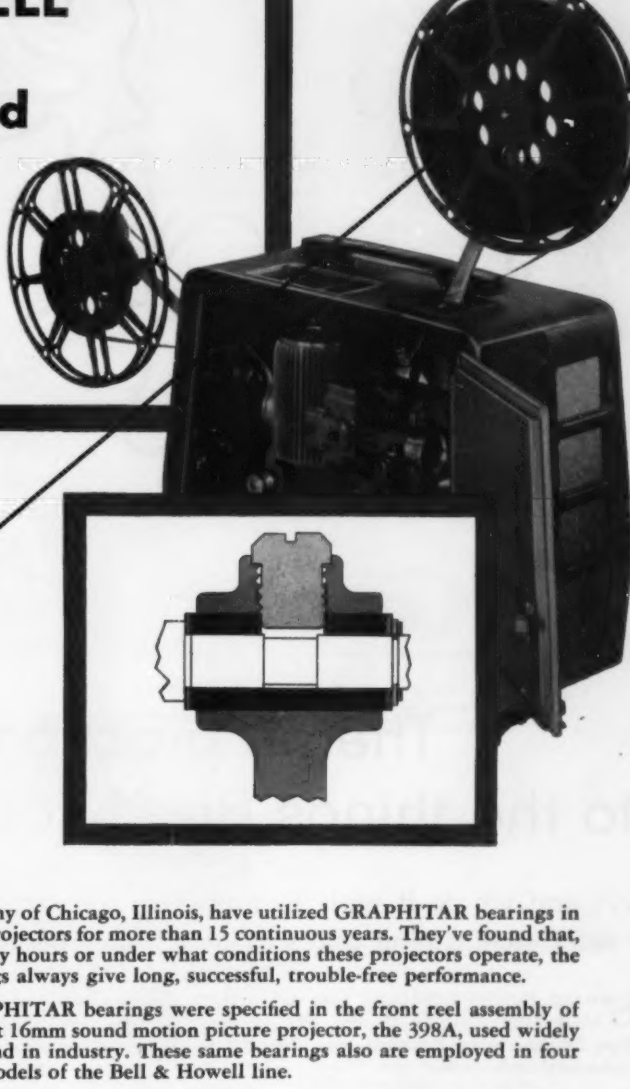
SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS

★Snap-Tite

ST-58-01

SNAP-TITE, INC. • UNION CITY, PA.

15 years of continuous success in BELL & HOWELL movie projectors prove quality and durability of GRAPHITAR® (CARBON-GRAPHITE) bearings



Bell & Howell Company of Chicago, Illinois, have utilized GRAPHITAR bearings in their motion picture projectors for more than 15 continuous years. They've found that, regardless of how many hours or under what conditions these projectors operate, the GRAPHITAR bearings always give long, successful, trouble-free performance.

For this reason, GRAPHITAR bearings were specified in the front reel assembly of Bell & Howell's newest 16mm sound motion picture projector, the 398A, used widely in schools, churches and in industry. These same bearings also are employed in four other higher-priced models of the Bell & Howell line.

The GRAPHITAR bearing in this application is typical of thousands of everyday uses for GRAPHITAR. Because of its unusual qualities of mechanical strength, resistance to chemical attack, lightness of weight and its self-lapping, self-lubricating properties, GRAPHITAR has been the choice of design engineers for use as seals, bearings, vanes, piston liners and many other parts. Perhaps GRAPHITAR will prove ideal in your application. Our engineers can assist you in utilizing GRAPHITAR to greatest advantage.

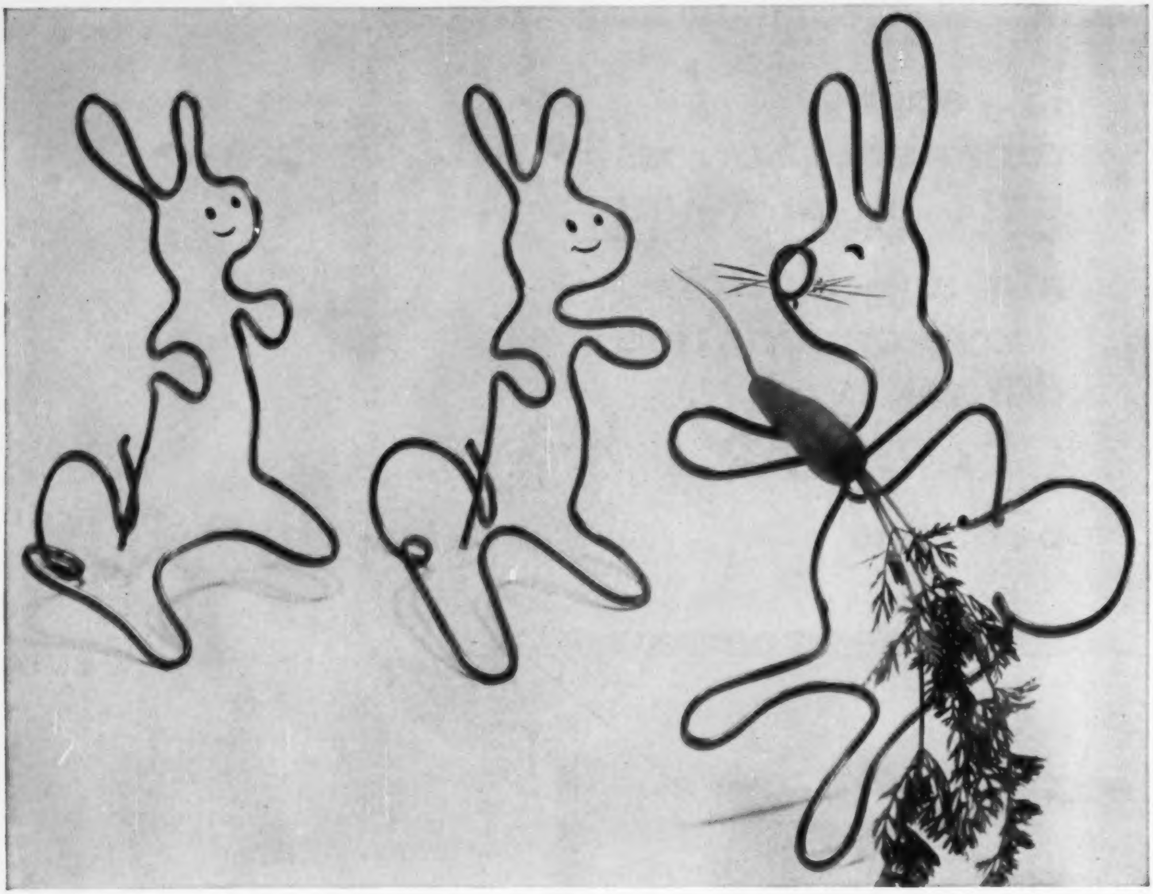
Bulletin No. 20 gives complete engineering facts on GRAPHITAR. Write for your free copy.

R-268-1

THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW 4, MICHIGAN

GRAPHITAR® CARBON-GRAPHITE • GRAMIX® POWDERED METAL PARTS • MEXICAN® GRAPHITE PRODUCTS • USG® BRUSHES



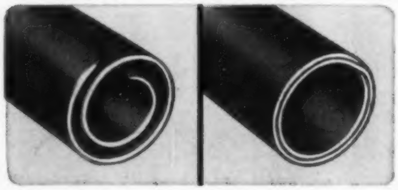
There's practically no limit to the things Bundy can mass-fabricate

... and we do it with Bundyweld, the stronger, safer steel tubing that's made for easy bending

SKILLED Bundy® technicians turn out many a strange shape—each to its exact tolerances. At Bundy, you get precision *in mass-fabrication.* Jigs, fixtures—even machines—are designed by Bundy specifically to cut customers' unit costs.

You get Bundyweld® Tubing, too. An exclusive process (right) gives it unique physical properties. So Bundyweld—master of volatile refrigerants and high-pressure brake fluids—has become the safety standard of two major industries.

Bundy engineers will design your tubing part, or work with you on its development. When we fabricate your parts, you can count on careful packaging, on-time delivery. Bring *your* tubing problem to Bundy. Contact us today!



Bundyweld is the only tubing double-walled from a single copper-plated *steel* strip, metallurgically bonded through 360° of wall contact for amazing strength, versatility.

Bundyweld is lightweight, uniformly smooth, easily fabricated. It's remarkably resistant to vibration fatigue; has unusually high bursting strength. Sizes up to ⅝" O.D.

There's no real substitute for Bundyweld Tubing

BUNDY TUBING COMPANY

DETROIT 14, MICHIGAN

WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING. AFFILIATED PLANTS IN AUSTRALIA, BRAZIL, ENGLAND, FRANCE, GERMANY, AND ITALY

TELETAX* TELEMETERING

by Foxboro...

engineered for the most advanced transmission techniques

Telemetering matched in performance with famous Foxboro instruments — that's the Foxboro Teletax Telemetering System.

Through use of impulse-duration signals, Teletax electrically transmits measurements of a remotely-located variable to the central control station. Here, the Teletax receiver records the duration of impulse, which is directly proportional to the measured variable.

The Foxboro Teletax System is noted for its simplicity, its versatility, and its high sustained accuracy. For a transmission medium, it can use either AC or DC, an audio frequency carried on a transmission line, or radio or microwave impulses. Sustained accuracy is 0.5% of full scale.

TELETAX RECEIVERS

Teletax receivers include: Single or Dual Receivers; Multi-Record Receivers for recording up to 6 separate measurements on one chart; and Teletax Receiver-Controllers for automatic operation. And the Teletax signal can be simply converted to digital information.

TRANSMISSION LINK

With Foxboro's Teletax Telemetering System, you can use the most advanced transmitting techniques: two wire lines, power lines, radio or microwave. As many as 25 different signals can be handled in each direction, simultaneously.

TELETAX TRANSMITTER

The Teletax Transmitter houses either one or two standard Foxboro measuring elements — plus the Teletax transmitting mechanism. It will transmit to a control center hundreds of miles away just as easily as to one nearby. It also indicates or records locally if desired.

The Teletax Transmitter needs *no* periodic maintenance whatever, while the receiver requires only occasional oiling. And the receiver has a minimum of mechanical components to wear — no clutch to slip or jam.

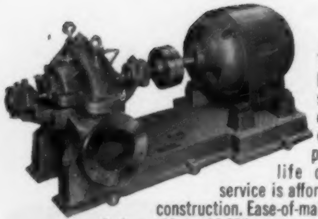
Foxboro Teletax Systems are now in wide use on natural gas systems, water works, oil fields, power plants, steel mills, etc. Write for Bulletin 17-11C — it gives all the details. The Foxboro Company, 962 Neponset Avenue, Foxboro, Mass.

*Reg. U. S. Pat. Off.

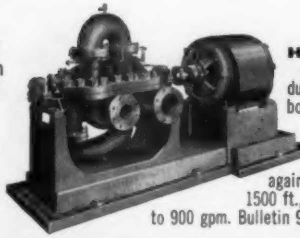
FOXBORO

REG. U.S. PAT. OFF.

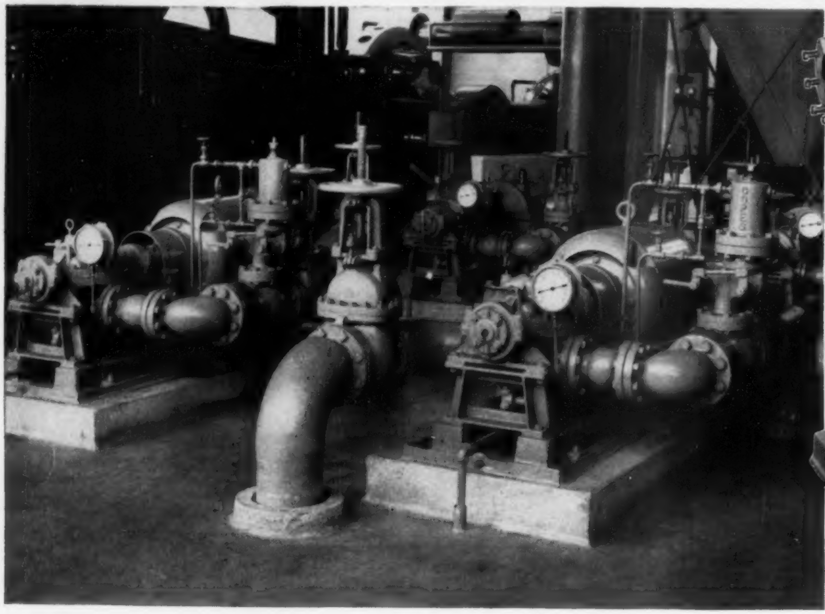
TELETAX TELEMETERING

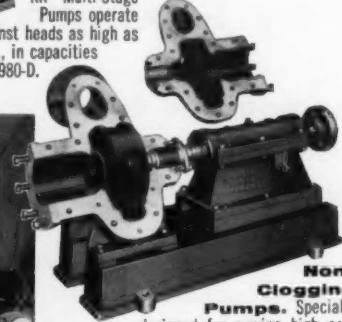


Clear Water Pumps. "Buffalo" Type "SL" Double Suction Pumps are designed for peak efficiency in clear water applications. A long life of economical service is afforded by their rugged construction. Ease-of-maintenance is a built-in feature. 10 to 14,000 gpm capacities. Bulletin 955-R.



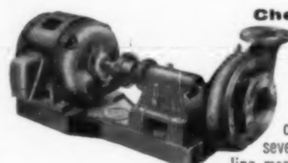
High Pressure Pumps. Offering efficiency, durability and dependability for boiler feed water and other clear water service, "Buffalo" Type "RR" Multi-Stage Pumps operate against heads as high as 1500 ft., in capacities to 900 gpm. Bulletin 980-D.





Non-Clogging Pumps. Specially designed for moving high consistency liquids, "Buffalo" Diagonally Split-Shell Pumps reduce down time, wear and "wedging". Rubber-lined models available for handling corrosive or abrasive liquids. Bulletin 953-K.

Heat Transfer Pumps. "Buffalo" Heat Transfer Pumps are widely used for handling high-temperature liquids. Ruggedly-built with special alloys, they utilize water-cooled bearings and packing. Efficient, single-suction, solid shell design. Write for application information.



Chemical Liquid Pumps. Choose from 10 special types of "Buffalo" Pumps in a variety of trim. Specially engineered for severe service in handling most corrosive, abrasive or high consistency liquids. Bulletin 982-A.

PUMPING EFFICIENCY TAILORED TO YOUR NEEDS

What are your liquid moving needs? Chances are, you'll find the right pump for your job from the complete "Buffalo" line.

You can rely on "Buffalo" Pumps to perform with maximum efficiency and dependability. Their rugged construction insures a long life of maintenance-free operation. Economy, too, is a big factor. For example, interchangeability of parts is designed into "Buffalo" Pumps through standardization. This saves you valuable dollars in lower parts inventories.

Add to these advantages the helpful services of the "Buffalo" engineering team, and you have every reason to choose "Buffalo" Pumps for your particular needs. This engineering know-how is backed by more than 80 years of broad experience in solving liquid moving problems.

Whatever your pumping needs, call in your nearby "Buffalo" representative. He'll be glad to help you select the pump best-suited to your job. Or write us direct for full information and bulletins.

"Buffalo" Pumps bring you the "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life.

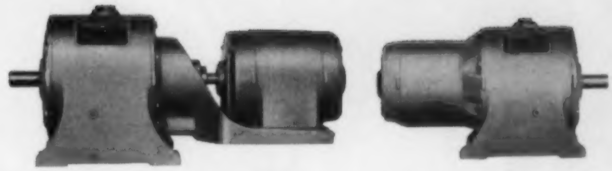
"Buffalo" PUMPS

BUFFALO PUMPS
Division of Buffalo Forge Co.
148 MORTIMER STREET • BUFFALO, N. Y.

Canada Pumps, Ltd., Kitchener, Ont. • Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

NOW AVAILABLE!

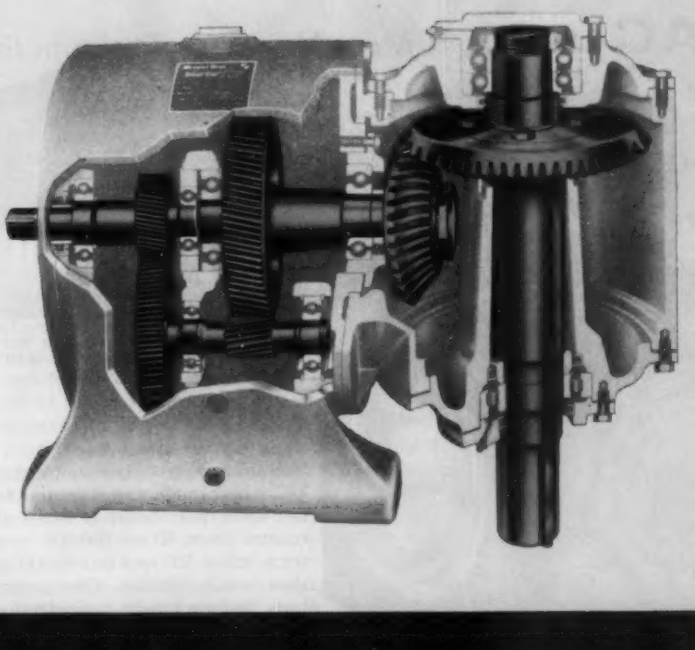


all-motor gearmotor *integral gearmotor*

Built-in customer benefits, engineered to customer needs for more than 25 years, make the Western Gear StraitLine Speed Reducers line the finest in the field. The reducer and right angle head pictured below are available in ranges from 1 HP to 75 HP, with or without motor. Let our engineers consider your needs.

WESTERN GEAR

STRAITLINE *speed reducers with universal-mounted right angle head!*



UNIVERSAL MOUNTING. The right angle attachment may be furnished in horizontal, vertical or intermediate positions with single or double extended shafts.

SPIRAL BEVEL GEARING. Precision cut from alloy steel forgings and case hardened for maximum strength and durability. Each set of gears is matched and lapped after hardening to insure good contact and quiet operation.

DRY WELL CONSTRUCTION. Time tested dry well construction prevents oil leakage down the output shaft for vertical applications.

OVERHUNG LOAD. Conservatively selected bearings, husky output shaft, and wide bearing span provide ample overhung load capacity for chain, pinion and belt service.

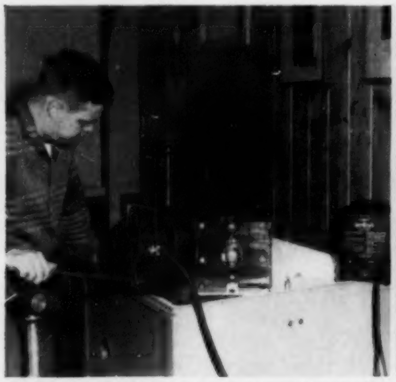
POSITIVE LUBRICATION. A simple splash lubrication system, integral with the main housing, thoroughly lubricates gears and bearings. Case design allows oil to be circulated freely at all times.

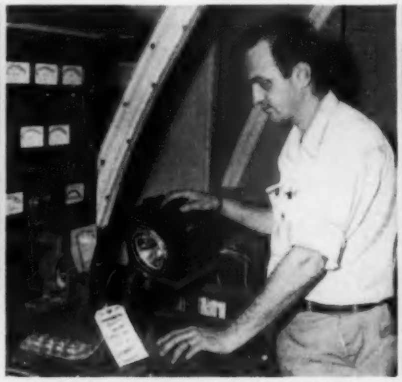
LESS MAINTENANCE. Only two alemite fittings are required to lubricate bearings when output shaft is in the vertical position. Large grease reservoirs are provided to insure positive lubrication.

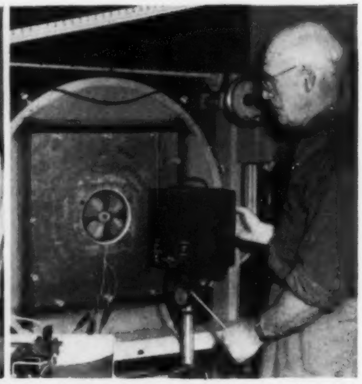
WG INDUSTRIAL PRODUCTS DIVISION

WESTERN GEAR CORPORATION
Industrial Products Division
P.O. Box 126 • Belmont, California
Send me Bulletin 5816F

*name*__________
*title*__________
*company*__________
*address*__________
*city*__________ *state*__________







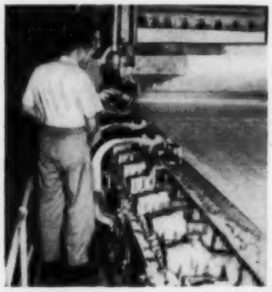
Rotron Research Corp. of Woodstock, N. Y., uses several dozen Strobotacs continuously in the design and production testing of its small fans and blowers, which are used in the cooling of electronic equipment. Typical tests include:

During vibration testing, Strobotac and Strobolux® auxiliary light source spot mechanical resonance present in a developmental vane-axial blower.

Motor-speed measurements under various loads imposed by dynamometer during production testing.

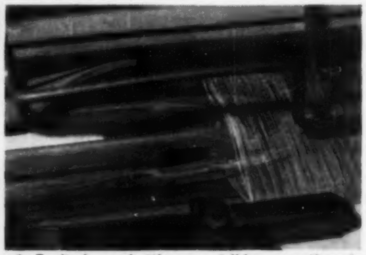
Measuring motor speed during air-moving capacity test of experimental fan in a standard NAFM test chamber.

OTHER INDUSTRIAL USES FOR G-R STROBOSCOPIC EQUIPMENT . . .



◀ A Strobolux in use at a typical paper mill helps observe water removal and sheet formation on a Fourdrinier wire.

Checking spindle speeds to an accuracy of ±1% at textile mill. ▶



▲ Faulty loom shuttle seen striking warp threads with aid of a Type 1532-B Strobolume.

STROBOTAC® *Industry's Most Versatile Tachometer*

★ Measures speed from 60 to 100,000 rpm.
★ Makes rapidly rotating, reciprocating, or vibrating objects appear in slow motion.
★ No physical connection between Strobotac and object under study — no drag or retarding effects imposed.
★ Permits maintenance checks on machinery, minimizing costly down time.

▲

Type 648-A Strobolux®. . . $300
An auxiliary white-light source with an intensity 100 times that of Strobotac. Flashing rate up to 6000 flashes per minute. Must be flashed from Strobotac. Can be used for single- or multiple-flash photography.

▲

Type 1532-B Strobolume . . . $275
A high-intensity white-light source 400 times as intense as the Strobotac for studies of looms and other low-speed machinery. Flashing rate up to 1200 flashes per minute, or up to 3000 per minute at reduced intensity. Flashing rate controlled by Strobotac, Type 1535-B Mechanical Contactor ($150), or any other make-or-break mechanism. Strobolume can be used for single- or multiple-flash photography. Cord with push button provided for manual control of flash.

◀

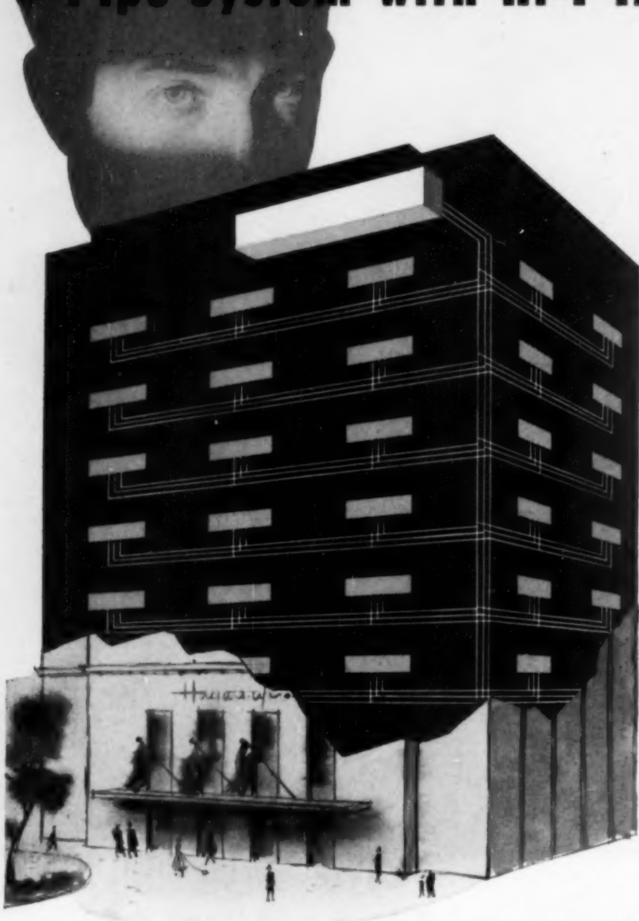
Type 631-BL Strobotac® . . . $170
Versatile, basic stroboscopic light source — flashing range; direct reading from 60 to 14,400 rpm; useful as electrical tachometer from 60 to 100,000 rpm, and from below 300 rpm to 100,000 rpm for slow-motion studies. One control adjusts flashing rate to desired value; dial readings accurate to ±1% over most of range. Operates from 115v a-c line.

STROBOTAC®

Manufactured Exclusively by

GENERAL RADIO Company 275 Massachusetts Avenue, Cambridge 39, Massachusetts

Look Inside YORK'S Revolutionary 3-Pipe System with Hi-I Induction Conditioners



See How It Simplifies Building Design... Cuts Primary Air Needs up to 75%... Requires No Air or Water Zoning

Based on YORK's new Hi-I induction conditioner, with greatly increased secondary coil capacities, this new air conditioning system can be designed for 75% less primary air than conventional systems. As a result, it may be sized for smaller primary air equipment, lower central fan horsepower, and smaller primary air ductwork. Reduces space requirements, installation and operating costs, and simplifies layout.

Zoning of ventilating air or supply water is no longer a problem. Constant quantities are delivered uninterruptedly to all points.

Avoids Power and Steam Cost Penalties
With the 3-pipe system, units are supplied with hot and cold water simultaneously as required during the year. Room temperatures are regulated by means of non-mixing automatic unit control valves. This completely eliminates summer-winter changeover and nighttime shutdown...offers dramatic savings in power and steam costs.

Added economies in central station equipment can be obtained by use of a YORK Air-Source Heat Pump or Lithium-Bromide Absorption System.

50% Greater Personal Comfort
YORK's new 3-pipe system with Hi-I induction conditioners makes possible a new concept in air conditioning. Built-in hot and cold water supply lines, with automatic unit control valve; provide instant response to temperature requirements of room occupants...permit 50% wider temperature variation from room-to-room. Quiet operation assured by YORK patented primary air nozzles.

YORK BW

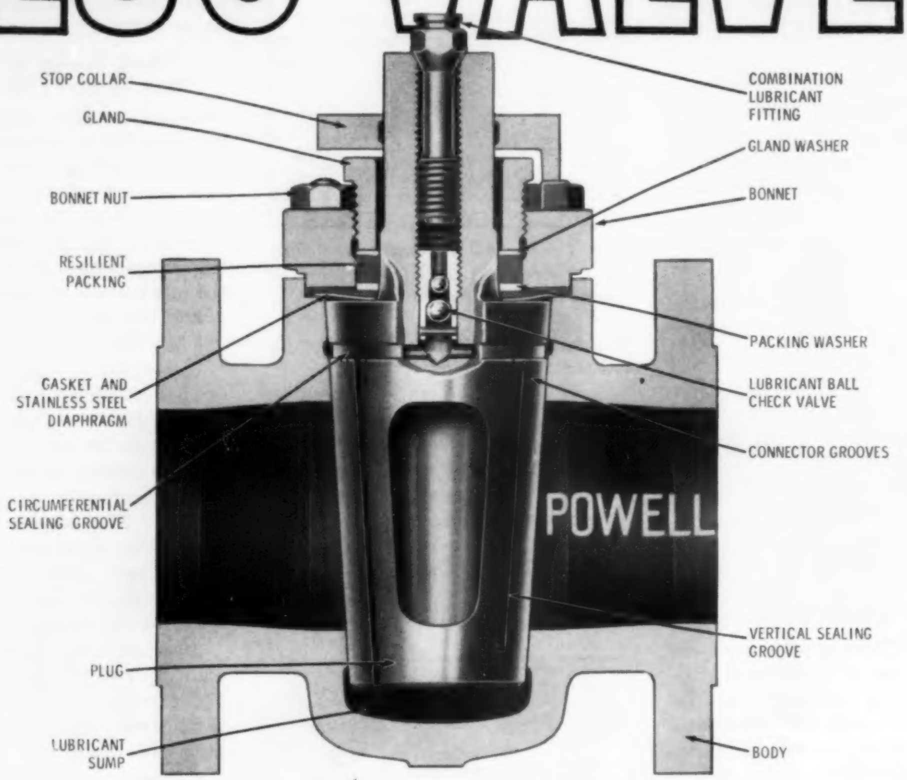
YORK CORP. SUBSIDIARY OF BORG-WARNER CORP.

BORG-WARNER
RESEARCH & ENGINEERING
MAKE IT BETTER

Air Conditioning, Heating, Refrigeration and Ice Equipment • Products for Home, Commercial and Industrial Installations

POWELL

LUBRICATED PLUG VALVES



Sectional view Powell Screwed Gland Lubricated Plug Valve.

Like all Powell Valves, Powell Lubricated Plug Valves are superior in their field . . . and have many advantages over other conventional types of Valves.

- Simple design: only three basic parts—Body, Bonnet, Plug.
- Quick, complete shut-off—a quarter turn will close or open the valve.
- Tapered Plug assures positive seating.
- Machined surfaces of plug and body are not exposed in the open position. Any media adhering to the plug when in the closed position is removed when plug is rotated.
- Cavity-free straight passage assures streamlined flow in either direction. Scale and sediment cannot collect.

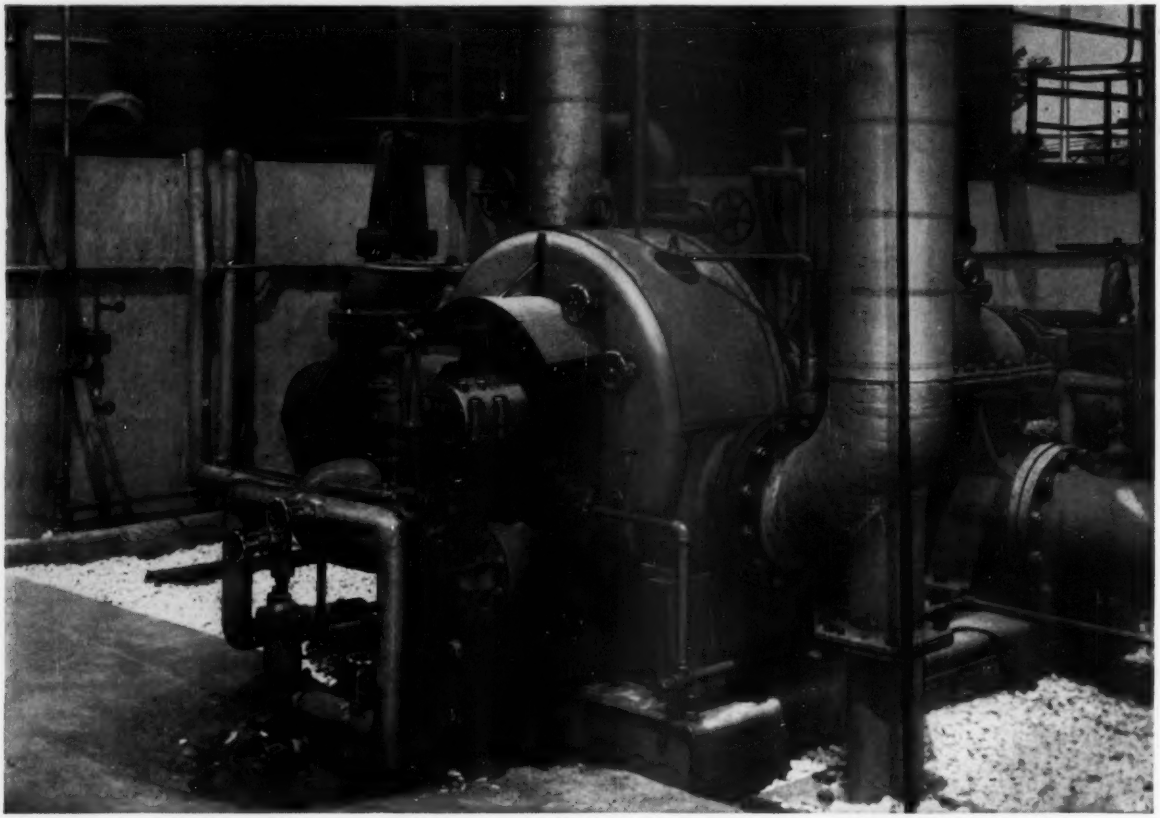
Powell Lubricated Plug Valves are available in sizes ½" through 16", depending on the type required—Semi-steel 175 and 200 pounds WOG;—Carbon Steel ASA 150 and 300 pounds.

Powell can also furnish Lubricated Plug Valves in other alloys on special order.

For all your valve needs, make it a policy to consult your local Powell Distributor—or write directly to us.

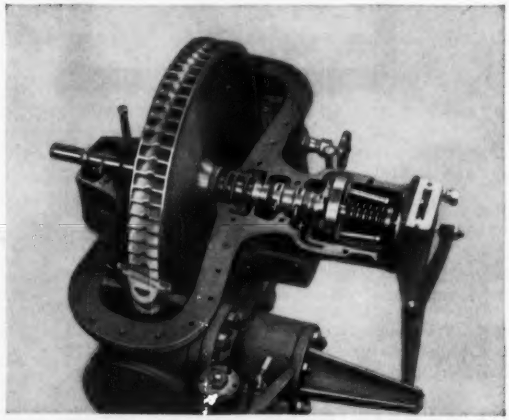
THE WM. POWELL COMPANY

Dependable Valves Since 1846 • Cincinnati 22, Ohio



TERRY SOLID-WHEEL TURBINES

used exclusively at Baton Rouge plant of W.R.Grace & Co.



The upper photograph shows one of the 17 Terry turbines installed at the Baton Rouge, La., GREX high-density polyethylene plant of W. R. Grace & Co. Above, a typical Terry solid-wheel turbine with cover removed to show the wheel construction.

In purchasing equipment for their new 50,000,000-pound high-density polyethylene plant, W. R. Grace & Co. standardized, wherever possible, on a single source of supply for each type of equipment used. Consistent with this policy, Terry steam turbines were used exclusively throughout the utility and process sections of the plant.

A total of 17 turbines were placed in service for driving pumps and fans. These are all of the solid-wheel type, ranging in capacity from 50 to 240 HP.

Terry solid-wheel turbines are known for their long life and sure dependability under the most-trying operating conditions. They feature a single-piece wheel which is virtually indestructible.

Send for details of these trouble-free turbines. Ask for a copy of bulletin S-116.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1214

MECHANICAL ENGINEERING

VOLUME 81 • NUMBER 2 • FEBRUARY, 1959

Engineers' Salaries

Your salary: Have you ever wondered how it compares with that of your fellow engineers? Do you often ask yourself, "Am I being compensated adequately for my job?" Or, "Would I be better off salarywise—in industry, education, or government?" The answers to these and many other questions regarding engineers' salaries can now be found in Engineers Joint Council's third study on "Professional Income of Engineers."

For example, the report points out that earnings of engineers continued their upward trend, observed in the previous survey interval, 1953–1956. The over-all median (for all graduates) was $6500 in 1953, $7750 in 1956 (19 per cent increase or about 6.5 per cent annually), and $8750 in 1958 (up 13 per cent from 1956 or 6.5 per cent average yearly). The latter represents an increase from mid-1956 to mid-1958. For this same two-year span the Consumer Price Index rose 1.5 per cent and the Average Gross Weekly Earnings for Production (Manufacturing) climbed close to 10 per cent.

The increases in engineering earnings are not distributed equally among the various activity classifications or among the experience levels of the survey. Summary results of the changes of the median lines for the general categories are presented in "The Roundup" of this issue.

Industry salary increases closely parallel the over-all average increments. Government increases on the other hand—for both absolute dollars and percentages—are above the average. This reflects the improvement which governmental agencies have been successful in securing in the past two years. A notable example of this was the flat increases granted by Congress in 1958 for Civil Service engineers in the Federal Government. Notable advances also have been made by state and local agencies. The relative rise above the industry increments has not, however, placed government employment in a competitive salary position with industrial employment, but has reduced somewhat the wide margins noted in 1956. Earnings of engineers in government continue to lag most seriously at experience levels beyond 12 years.

The EJC studies revealed a strong upward trend in earnings in industry between 1953 and 1956. Although industry, particularly, was adversely affected by the recent recession, this upward trend in earnings continued, although at a slightly reduced rate.

Following a more extended explanatory text than in previous years, the report contains 41 tabular and graphic presentations: Comparison of median lines—1953, 1956, 1958; all activities combined; all industries, with 26 subdivisions, including separated PhD/ScD and MS graduates; all levels of Government with separation of Federal, state, local, as well as graduates with advanced degrees; college teachers—teaching salaries and total income, with separation of PhD/ScD and MS graduates; technical-institute teachers—teaching salaries and total income; engineering societies and magazine staffs.

Included in the survey were 190,810 engineering graduates divided as follows: Industry—546 companies, 155,124 engineers; government—131 agencies, 30,028 engineers; education—5658 engineers.

This study is probably the most comprehensive ever made in the U. S. on engineers' salaries and represents a monumental task. It should command the attention of all engineers in all fields.

The report, "Professional Income of Engineers—1958," is available from Engineers Joint Council, 29 West 39th Street, New York 18, N. Y., at $3 per copy.—*J. J. Jaklitsch, Jr.*

By Everett M. Barber, Mem. ASME[1]

Special Engine Research Department,

Beacon Laboratories,

The Texas Company, Beacon, N. Y.

ASME's Research Committee Program

More than 20 research committees with almost 700 persons participating in their programs have produced many definitive results of lasting value to the mechanical-engineering profession. ASME members are provided a valuable opportunity to work together in ways that tend to develop and improve their own personal knowledge and acquaintance in a selected field.

For many years The American Society of Mechanical Engineers has considered the support and stimulation of engineering research as one of the important ways in which it could be of service to its members and to the engineering profession. ASME's organized research was begun in 1909 under the leadership of a Main Research Committee, which was established as a standing committee of ASME's governing body, the Council.

The Main Research Committee was responsible for organizing and fostering research committees to deal with research in the various fields of mechanical engineering. To assist in this work, the Main Research Committee received an annual appropriation from Council; a small research staff was maintained, and liaison was established with the Professional Divisions, Sections, and Technical Committees to provide awareness of the research needs and interests of the entire Society membership.

By 1927 there were 24 ASME research committees composed of 290 members, and there were 70 persons working full or part time on projects sponsored and/or financed by these research committees. The program continued to develop satisfactorily until a decline set in for several years during and immediately after World War II.

Reorganization Plan, 1951–1952

In November, 1952, the Council acting on the recommendation of a special committee previously appointed to re-examine research policy and organization "reaffirmed its conviction that a strong and vital program of research is an essential phase of the services of the Society to its members and to the engineering profession." Two broad objectives were cited: (*a*) To develop a strong and vital program of research consistent with the technological needs of the profession. (*b*) To stimulate and train capable engineers to carry on engineering research.

The Council also adopted recommendations to establish the following research organization under the Board on Technology:

1 *Research Executive Committee*, composed of five members, was established with broad responsibilities for administrative procedures and policies of ASME research.

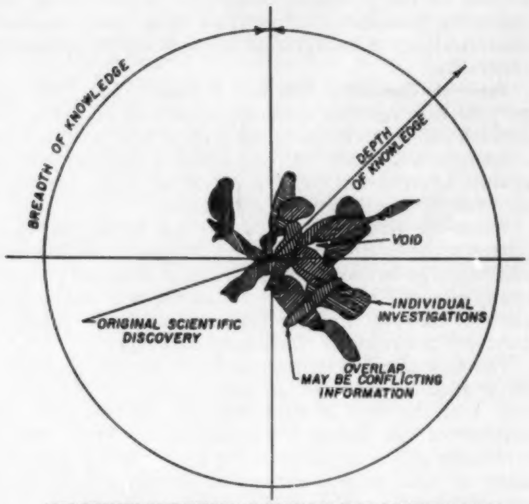
2 *Research Planning Committee*, composed of the Research Executive Committee, representatives of the research committees, representatives of the professional divisions, and the Research Manager, was established with responsibility to bring in new projects and to review and evaluate existing projects.

3 *Research Manager* was established as a full-time staff position.

Experience Under the New Plan

There has been considerable progress in the direction of Council's objectives. A substantial number of new research committees have been formed and many of the older committees have been revitalized. It soon became apparent that only a small number of members were aware of the ASME Research Committee Program, of the work that it was doing, and of the opportunities

[1] Past-chairman, ASME Research Executive Committee.



THE PURPOSE OF ENGINEERING RESEARCH IS TO ACHIEVE A SOLID MASTERY OF THE FIELD, OR OF A SELECTED SEGMENT OF THE FIELD TO THE GREATEST USEFUL DEPTH. THIS IMPLIES A SYSTEMATIC PROCESS OF CRITICAL REVIEW TO LOCATE THE VOIDS AND CONFLICTS, FOLLOWED BY INVESTIGATIONS TO FILL THE VOIDS AND TO RESOLVE THE CONFLICTS. THIS PROCESS CAN BE CLASSED AS "BACKGROUND RESEARCH".

Fig. 1 Development of engineering knowledge in a field of technology

that it offered to them. Consequently, a definite effort has been made to establish and maintain communications between the Research Committee organization and the Societies' members. Two principal mediums of communications have been established on a continuing basis: (*a*) The Research Planning Committee meetings have been organized as a forum in which ASME members' research interests can be presented and discussed; (*b*) an Annual Report of ASME Research (ASME Annual AC-2) is prepared and is made available to interested Society members.

Both mediums have been relatively successful; they have resulted in a rapid growth of ASME members' expressions, interest, and actual participation in the Research Committee Program and in a sharp increase in the rate of formation of new research committees and research projects.

At present there are more than 20 research committees with almost 700 persons participating in their programs, and several proposals for new committees are being considered. These research-committee members contribute their services, pay their own expenses, and solicit money and/or contributed services to conduct their programs. ASME provides a responsible name, a degree of co-ordination and a one-man secretariat to aid them. ASME also serves as custodian of the solicited funds, at a charge of 10 per cent, so that these research-committee activities involve little or no out-of-pocket expense to the general membership.

Currently, the expressions of members' interests and the proposals for the formation of new and worth-while projects are occurring at such a rate that it will be necessary to increase the schedule of Research Executive and Research Planning Committee meetings, and to augment the staff assistance so that these matters can receive proper consideration without undue delays. Also, it may become desirable for Council to resume the earlier practice of granting a small appropriation to aid in developing the program.

"Background Research" by Committee Action

The ASME Research Committee Program is small when judged in comparison with the technological needs of mechanical-engineering practice. Nevertheless, it is the only such program known to be conducted by a major engineering society and, by concentrating attention on those things that volunteer committees are uniquely able to do well, it has made disproportionately large technological contributions.

For the continuing operation of the program it is essential to have certain general ideas well established and known to all ASME members. Some of the more important of these ideas will be discussed.

Purpose and Scope. Research is a popular word, but a fuzzy concept that means different things to different people. In the present context it will be limited to the field of mechanical engineering; and the term "engineering research" will mean mechanical-engineering investigative activity aimed at increasing and improving the technology available for the practice of mechanical engineering.

The term "background research" suggested by Vannevar Bush[2] to denote this type of investigative activity needs some analysis to insure general understanding. For this purpose, it is convenient to think of a field of technology as a polar diagram, Fig. 1, in which the radius represents depth of knowledge in the field and the angular co-ordinate represents breadth of the field. The origin of co-ordinates can be regarded as the original scientific discovery or collection of facts that opened up the possibility of engineering exploitation of the field.

The shaded areas on the diagram represent islands of knowledge recorded in the literature as a result of research, development, and/or practical experience. In any field there are voids between islands of knowledge and there are overlaps, some of which represent conflicts of information. Also, islands of knowledge usually become sparser at greater depth.

In a given field, a mechanical engineer is expected to practice with sureness at a depth where the technology is free of voids and conflicts, that is, at a depth where the profession as a whole has established a "solid mastery" of the technology. Conversely, engineering practice cannot be expected, without preparatory research, at a depth substantially greater than that of solid mastery.

Obviously, an important way of improving and increasing available technology will be to seek out the voids and conflicts in important fields, and then, to seek information which will extend the area of solid mastery.

The foregoing ideas lead to a workable concept of background research as the critical evaluation and development of a selected field of technology to define and extend the area of solid mastery.

Some Characteristics of Committees. A facetious publi-

[2] "Science: The Endless Frontier," A Report to the President, by Vannevar Bush, Director OSRD, U. S. Government Printing Office, Washington, D. C., July, 1945, Appendix 3, p. 76.

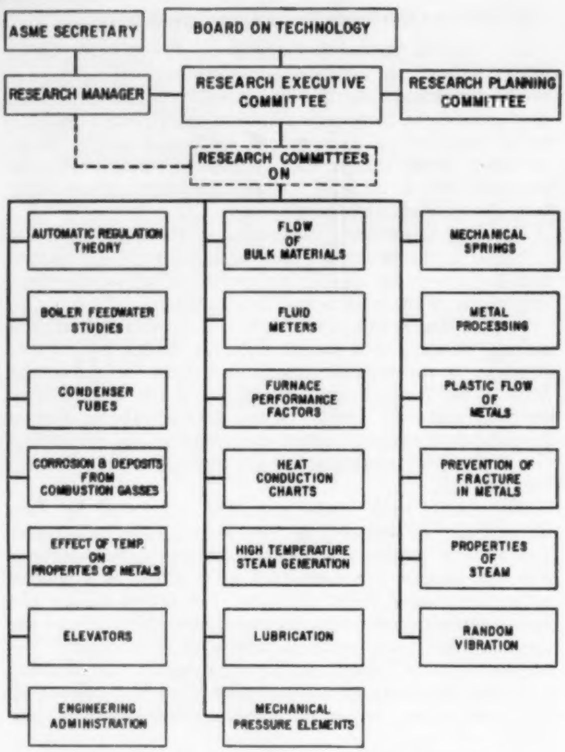


Fig. 2 ASME Research Committee organization

cation[3] proves with irrefutable logic that the optimum size of a committee is seven tenths of a man. In the sense that there are a lot of things that a committee cannot do as well as an individual, this is a sound conclusion. A committee, however, can have a greater depth and breadth of experience and diversity in point of view than an individual, and a carefully selected committee is far better qualified than an individual to: (*a*) Prepare or supervise the preparation of critical reviews of selected areas of technology in a way that improves perspective, highlights the needs and opportunities of specific research, and stimulates potential applications; (*b*) stimulate and/or plan, sponsor, support, and supervise research, particularly where broad acceptance of the result is desired; (*c*) create an environment that stimulates accomplishment by individuals.

Obviously, it will be desirable to construct both the ASME Research Committee Program and the committee procedures to exploit the things that committees are uniquely well able to do and to avoid those types of research that are better done by individuals or companies.

[3] Bruce S. Old, "On the Mathematics of Committees, Boards, and Panels," *The Scientific Monthly*, vol. 63, August, 1946, pp. 129–134.

General Characteristics of Operations

It is self-evident that background research is well adapted to the committee type of research. Many aspects of the program, committee organization, and operating procedures follow from these complementary characteristics of background research and of committee capability.

Research Committee Title and Purpose. The title and purpose of a research committee combine to define the breadth and depth of the technological field in which the committee will work. A comparison of title and purpose against effectiveness, over a period of years, reveals a surprisingly high degree of correlation.

When the title and purpose are too broad, the committee becomes discouraged and confused; its interests and efforts go in too many directions at once and progress in any direction is too slow. When the title and purpose are too narrow, interest lags and a single practical difficulty can stop the committee altogether.

The Research Committee on Fluid Meters appears to be a good example of an apt choice. If we regard Fig. 1 as the field of fluid flow, the specific title and purpose of the Research Committee on Fluid Meters represents only a segment of the field. It is a segment, however, that is large enough to contain a challenging array of problems that are of particular importance to the practice of mechanical engineering.

In the formation of a new research committee, a useful test of title and purpose is to try to visualize a written critical review of the chosen segment. If it can be covered in a single volume with due regard to unity and coherence it is about the right size; if a chapter will do it, it is probably too narrow; and if it will require multivolume or handbook treatment it is too broad.

Standing Committees Versus Ad-Hoc Committees and Committee Procedures. Within the concepts of the ASME Research Committee Program there are places for standing committees and for ad-hoc committees.

The title and scope of an ad-hoc committee usually will result in specific research in a specific technical field; that is, it will often be doing the sort of work that is better done by an individual or a company. In general, this is not the most effective use of committee capability. One important and desirable use of an ad-hoc committee, however, is to use the committee's collective breadth and depth of knowledge and experience to plan and supervise a specific research where particularly broad acceptance of the result is desired. The Research Committee on Properties of Steam is an example of an ad-hoc committee doing a specific research for which it is desirable to obtain practically world-wide acceptance of the result.

For background research, a standing committee usually will be most effective. A critical review to disclose the voids and conflicts of the technology that falls within the research committee's title and purpose can be considered to be the first and fundamental action. Thereafter, the committee should work to develop information that will fill the voids and resolve the conflicts. Several techniques can be used: (*a*) The research committee can stimulate specific research by individuals and organizations; (*b*) the research committee can solicit publication of pertinent unpublished information; (*c*) the research committee can plan, sponsor, or support, supervise and publish its own research.

When sufficient information has been accumulated to fill voids and resolve the conflicts shown by the initial review, an up-to-date revision should be prepared. This may suggest terminating the research-committee's activities or it may suggest further developments to increase the depth or breadth of solid mastery.

Again the Research Committee on Fluid Meters can be cited as an example. This committee, organized in 1916, is currently issuing the fifth edition of its review. It has employed all of the techniques that have been mentioned for accumulating information, and in its 42 years of existence it has stimulated an enormous advance in this segment of mechanical-engineering technology. Each new edition of its review has stimulated and guided many individual researches; at times as many as 200 individuals or organizations are known to have been doing research highlighted by its reviews. More or less as a by-product, its reviews have come to be looked upon as *the* authoritative source book on fluid meters.

While there is a place in the research program for both standing committees and ad-hoc committees, it is evident that the standing committee is best adjusted to the broad objectives of the program and to the characteristics of committees. Hence standing committees will predominate. During the war years, research and development need and interest were predominantly in very specific projects. There is evidence that the attendant emphasis on ad-hoc-type research-committee projects contributed to the decline in the ASME Research Committee Program during and after the war. When people had become persuaded that background type of activities were not wanted they tended to withhold their suggestions; but their thoughts on specific researches tended to be withheld also since most of these obviously were better suited to be done by individuals or companies.

Appropriate Size of the ASME Research Committee Program. Some persons have feared that research might proliferate out of all bounds. Two relatively objective safeguards are inherent in the ASME Research Committee Program:

1 The working definition of background engineering research suggests that, for each field on which the profession has developed less than a solid mastery to the maximum useful depth, it will be worth considering the contribution that an ASME research committee can make. Applying this test to the present program, it must be considered too small.

2 A second safeguard lies in the selection of projects and personnel. ASME research committees are authorized only on the initiative of ASME members who will go to the trouble of preparing and presenting a convincing case to the Research Planning and Research Executive Committees. Research-committee members are selected as individuals (not as representatives of companies or special interests) who are best qualified in the field regardless of whether or not they are ASME members. When a group, conceived in this manner, is willing to contribute its own services, pay its own expenses, and solicit funds for the work it proposes to do, it is a reasonable presumption that the work is worth doing.

Education and Training in Research. One objective of the program is to stimulate the training of capable young engineers to carry on engineering research. When a vigorous research-committee program exists, four practices by the research committees will tend to maximize the education and training value of the program: (*a*) The dissemination of critical reviews will stimulate able young engineers to follow up the research opportunities that are disclosed; (*b*) the research committees can develop a bias in favor of letting contract research to educational institutions under conditions that will support graduate study; (*c*) the research committees can encourage thesis projects within their field; (*d*) the research committees can invite promising young engineers to serve as members of technical subcommittees.

Present Status

An outline of the present ASME Research Committee organization, including the titles of the existing ASME research committees, is shown in Fig. 2. The number, title, and purpose of the research committees and the level of activity in any one of the committees fluctuate considerably with time reflecting ASME members' research needs and interests within the field of the research committee's title and purpose.

Several of the committees, for example, Random Vibration, Flow of Bulk Materials, and Prevention of Fracture in Metals, are relatively new with programs in the formative stages. In contrast, the Research Committee on Mechanical Springs is relatively mature and its members seem to feel that they have developed this subject to as great a depth as is desirable at this time and the committee probably will be disbanded. Two of the oldest committees, Research Committee on Lubrication, appointed in 1915, and Research Committee on Fluid Meters, appointed in 1916, both find a need for continuing background research in their fields and are more active now than at any time in their history. The Research Committee on Plastic Flow of Metals is another interesting case. Its purpose has been confined to plastic flow in rolling steel. Recent expressions of ASME member interests strongly suggest that this title should be retained but that the purpose and membership of the Committee should be adjusted to admit a much broader surveillance of this important field.

It has been mentioned that almost 700 persons participate in this Research Committee Program and that they solicit funds and contributed services to support their committees' research programs. The current annual value of cash contributions is substantially in excess of $100,000, and contributed services, although somewhat difficult to assess exactly, evidently run several times that. The value of contributed personal services cannot be estimated. Aside from dollar value, it brings to the committee's work a quality and variety of talent that no company could hope to assemble. It is hardly surprising that the research committees have tended to produce many definitive results of lasting value.

Conclusions

The ASME Research Committee Program provides exceptional guidance for the systematic development of the technology involved in various selected fields of mechanical engineering. It provides valuable opportunities for ASME members to work together in ways that tend to develop and improve their own personal knowledge and acquaintance in the selected field. The Research Committee Program also guides and stimulates work by others, and serves as an incentive and a training ground for promising young engineers.

The National Science Foundation is concerned largely with the support of engineers in basic research in areas of mutual interest to the various fields of engineering. The method of applying for research grants, their scope, and some of the types of mechanical-engineering research that are being supported are discussed.

NSF's Basic-Engineering Research Program

By Gene M. Nordby,[1] Program Director, and Ralph H. Long, Jr.,[2] Mem. ASME, Engineer, Program for Engineering Sciences, National Science Foundation, Washington, D.C.

ARE THE engineers and scientists of this country as a group negligent in providing and promoting their share of basic research? The concluding paragraph of a recent article [1][3] by R. G. Folsom is worth repeating: "Fundamental research is an investment in the future that must be supported by all engineers. It is particularly important to mechanical engineers who want to lead in their fields. Have you given any thought to how you are upholding fundamental research in mechanical engineering?"

There are clear indications [2] that the basic-research capabilities of this country are not being fully realized, due to lack of adequate financial support. The role of the National Science Foundation will be outlined here, because a large segment of the engineering profession is not aware of its functions. The research activities are described, but not the fellowship programs.

Basic research or the pursuit of new scientific information is the keystone upon which applied research and development are built, and in fact is one index of a nation's scientific stature. Certainly these were some of the thoughts of Vannevar Bush when he made his 1945 report on our nation's shortcomings and obligations in research, and Congress in 1950 took remedial action by creating the National Science Foundation, a special governmental agency, to encourage and stimulate basic research in engineering, physical, and other sciences. One phase of this stimulation consists of granting funds, primarily to colleges and universities, to carry on various research and educational activities.

The National Science Foundation is limited by law to the support of "basic research." Many persons, including engineers themselves, think of the engineering sciences as being wholly within the applied region. One difficulty is that the change from basic research to development, to application, and manufacture is a smooth one with no defined dividing line. In fact, the interests of engineers vary in a continuous spectrum from the engineering-scientist researcher to the design engineer and on to the production engineer. NSF is concerned largely with the support of engineers at the scientific end of this spectrum. Philosophically, basic research may be defined as a quest for knowledge with intellectual curiosity as the primary motivation, but a program of research support cannot be administered on this basis alone.

Research in engineering sciences [3] does not ordinarily fit into the usual classification of aeronautical, chemical, civil, electrical, or mechanical engineering, but rather in areas of mutual interest to these fields, such as fluid mechanics, materials, thermodynamics, and similar categories. Basic research has as a goal the better understanding of why and how nature acts, and it widens a field of knowledge and deals with new principles. Some Federal agencies and private industries need to reach a definite objective in a limited time and usually concentrate their support in problems which are most likely to develop or improve a product, and they usually also support those who have already achieved a reputation of accomplishment. NSF is in a position, however, to support research in the engineering sciences having no immediate goal or application, and further may support a young scientist who proposes meritorious basic research with the additional objective of increasing his value to the nation.

The amount of money required for NSF to carry out its functions has not been accurately determined. The annual budget has risen to 40 million dollars[4] per year for all of its functions. Already the expenditures in engineering sciences have risen from only $42,000 in 1952 to over $1.5 million per year. The total expended in the engineering sciences (exclusive of fellowships) was $1,367,350 in the fiscal year ending June 30, 1957, and $1,545,030 in the fiscal year ending June 30, 1958. Already the impact of its program can be felt in research throughout the nation, and several noteworthy papers have appeared in the journals of The American Society of Mechanical Engineers.

Mechanical-Engineering Research Activities. A summary of two grants will give a better perspective.

E. G. Thomsen at the University of California, Berkeley, has studied the extrusion of axially symmetrical shapes and shapes extruded in plane strain. This theoretical and experimental study has produced seven published papers, four in the *Transactions of the ASME* and two in the *Journal of Applied Mechanics*.

Research in nonlinear mechanics by Karl Klotter at Stanford University is also being supported by NSF. He has used the Ritz averaging method for handling nonlinear problems in feedback control systems. Some of the results were presented in a paper given at the ASME Instruments and Regulators Division Conference, Princeton, N. J., March, 1956, and published in the *Transactions of the ASME*. Professor Klotter also presented "An Extension of the Conventional Concept of the Describing Function" at the Symposium on Nonlinear Circuit Analysis, Polytechnic Institute of Brooklyn, in April, 1956; and a third paper resulting from this research was presented at the Conference on Automatic Control in Heidelberg, Germany, September, 1956.

There has also been wide support for research in heat and mass transfer by mechanical and chemical engineers. Other basic studies in process which are being supported include nucleate boiling, mechanics of cavitation damage, slag-metal interactions during welding, fluid-

[1] Now at University of Arizona, Tucson, Ariz.
[2] Now at Illinois Institute of Chicago, Chicago, Ill.
[3] Numbers in brackets designate References at end of paper.

[4] Congress approved a budget of $135 million for the 1959 fiscal year.

film lubrication, high-temperature corrosion of alloys, collection of solar energy on plane surfaces, and the application of shallow-shell theory to analysis of buckling phenomenon. NSF does not specify areas of work for support and this diversity indicates the wide interests of the researchers who have been assisted.

The primary activity of the Engineering Sciences Program of the National Science Foundation is based upon the research proposal. The applicant includes in this such items as a brief history of the topic proposed for study, the proposed theoretical and experimental work, a budget, bibliography, and the biography of the investigator. The budget may contain contributions to the investigator's salary, the salaries of graduate assistants, equipment, travel, and other items needed to carry on the research. The proposal is reviewed by a number of engineering specialists in the particular field of interest in which the project falls. The qualifications of the applicant, the character of the research environment provided by his institution, and the subject of the particular proposal are all considered. In the past five years, over 600 reviewers have contributed their services in evaluating proposals for the Program for Engineering Sciences. In addition, the Program is advised by the Advisory Panel for Engineering Sciences, a group of distinguished engineering scientists selected from all fields of engineering. A proposal which has been favorably reported by reviewers is submitted to the National Science Board for approval, and then, if funds are available, a grant may be made.

The grants themselves are simple and flexible. They are, in a sense, gifts, and consequently there is a minimum of reports and detailed information requested from the grantee. The Foundation does request a semi-annual financial statement and six copies of any publications that result from the grant, but the principal investigator is encouraged to publish in existing journals rather than to submit detailed reports to the Foundation. Equipment purchased through the grant normally becomes the property of the institution.

Changes in the rate at which research progress is being carried out on a specific project, or changes in the direction of the research lie in the hands of the principal investigator working within the framework of his institution. There are no rigid deadlines, nor is there any pressure to produce a specific result or to solve a particular problem. The grants are designed to make it simple to do research, to enhance the teaching abilities of the investigator, and to fit in smoothly with academic life. Sometimes a new activity is "seeded" at an institution which has competent investigators but lacks the necessary equipment to pursue actively an area without financial assistance.

In seeking research support, the first and most important step is the conception of the fundamental idea. A general indication of the area of work to be done and a request for funds will usually be considered by reviewers as indicative of a lack of understanding or concentration on the topic. The problems chosen for support are those which are precisely described and on which considerable care and thought have been lavished so that they pinpoint a problem and propose a solution. While the proposed procedures may not always be fruitful, the grant flexibility allows changes to be accomplished simply.

Other activities which are included in the Engineering Sciences Program are the support of conferences for dissemination of scientific information and travel grants for attendance at international meetings. Engineers recognize the value of small conferences dealing with subjects of limited scope where discussions are extensive. As a rule the subjects discussed are the frontiers of knowledge where ideas are in a state of flux and where the sharing of ideas is most beneficial. Such a meeting was held at the Pennsylvania State University in June, 1955, sponsored by NSF and ASEE on Thermodynamics and Engineering. The object of this conference for engineering teachers was to discuss what is new in thermodynamics and how it can be incorporated into the curriculum. Papers presented at the conference were published. Support of a conference usually originates with a group of scientists doing active research in the field or with a society or institution concerned with the problem.

Other meetings of an international nature are also supported if held in the United States. NSF contributed to The World Conference on Earthquake Engineering in 1955, the International Conference on Irrigation and Drainage in 1956, and the World Conference on Prestressed Concrete in 1957. This support is usually for travel expenses for speakers, simultaneous-translation services, or the publication expenses for the proceedings.

Foreign meetings are supported by making travel grants to participants from this country, usually round-trip tourist air fare to the place of meeting. Eighteen engineers were sent to the 9th International Congress for Applied Mechanics in Brussels in 1956, and two engineers to the Conference on Thermodynamics and Transport Properties of Fluids in London in 1957.

In addition to research grants, the Foundation has made facilities grants in other fields. The Radio Astronomy Facility in Green Bank, W. Va., the Reactor Facility at M.I.T., and computer facilities at various universities in the country are examples. The Engineering Sciences Program is now studying the major facilities needed for basic research in engineering schools throughout the country, both on a geographic and a subject-area basis. The American Society for Engineering Education has recently completed a detailed study of these needs with the assistance of an NSF grant [2]. Preliminary estimates show this need to be extensive—in the amount of several hundred million dollars. The Foundation is also trying to establish the extent of governmental responsibility in furnishing these needs. However, one of the problems connected with these large facilities is the continuing cost of operation and maintenance after they are established. Continuing Federal support threatens an indefinite financial burden, a claim against future appropriations, and a degree of control over science that the Foundation does not seek

References

1 R. G. Folsom, "Research and Higher Education," Mechanical Engineering, vol. 80, July, 1958, pp. 34–37.

2 "A Survey of Research in the Nation's Engineering Colleges, Capabilities and Potentials," ECRC of ASEE, 1958. Available from the Secretary of ASEE, University of Illinois, Urbana.

3 G. M. Nordby and R. N. Faiman, "Engineering Sciences—Still Another Look," *Journal of Engineering Education*, vol. 48, March, 1958, pp. 527–529.

Note: Detailed procedures for the securing of NSF grants may be found in the booklet, "Grants for Scientific Research," prepared by the Foundation and available from the Program Director for Engineering Sciences, National Science Foundation, Washington 25, D. C.

THE UTILIZATION OF WASTE HEAT

Sound waste-heat utilization should be built around a continuous rather than a batch process, and it should contribute either to the process itself or to auxiliary operations. Gas, liquid, vapor, or solid may be used to absorb heat from a high-temperature source, then physically convey or transport this heat to a lower-temperature receiver.

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When a product leaves a process at a temperature in excess of the temperature of the surroundings, a possibility for the recovery of waste heat exists. Although most applications involve gaseous products, heat is also recovered industrially from liquids and solids.

Thermodynamically, all of the energy in the waste products may be recovered between the temperature of the product and the sink temperature provided by the surroundings. Practically, however, the presence of irreversible processes, and the impossibility of attaining adiabatic vessels, prevent this realization. The amount of heat recoverable is a function of the type, pressure, temperature, and state of aggregation, as well as the quantity, of the product.

The movement of the waste product involves an energy input which is often overlooked in superficial analyses of heat-recovery schemes. The power consumed by fans, compressors, pumps, grates, and so forth, must be charged against the recovery system, as well as the heat leakages and pressure losses in the connecting lines.

In general, a sound waste-heat utilization project will be built around a process with continuous rather than batch operation. Also a careful estimate of the probable number of operating days per year should be available.

The justification for waste-heat recovery in a given process depends upon: (*a*) Improvement of the process itself, as in the preheating of gas and combustion air to increase the efficiency of combustion in a furnace; (*b*) contributing to the improvement of a larger system of which the process is a part, such as operation of waste-heat boilers, gas turbines, or space-heating facilities; (*c*) providing external services, such as production of steam or power for sale to an adjacent factory; (*d*) combinations of these.

The *sources* of waste heat are to be found in: (*a*) *Gases*, particularly products of combustion, but also high-temperature effluent gases from chemical and metallurgical operations; (*b*) *liquids*, such as jacket cooling water from internal-combustion engines or many of the products from refineries and chemical plants; (*c*) *vapors*, as in some power and refinery operations; (*d*) *solids*, as in the cement and ceramics industries.

In addition to recovery from each of the foregoing categories as products, each of them may be considered separately as a "vehicle." In other words, a gas, liquid, vapor, or solid may be used to absorb heat from a high-temperature source, then physically convey or transport this heat to a lower-temperature sink. For example, waste gases at high temperature could be used to supply energy for a closed-cycle gas-turbine system. In such an operation the gas passing through the turbine would be the vehicle. Other examples would include the pebble heater, in which heat stored in solid particles is given up to low-temperature gas after the solid particles have been moved from a heating to a cooling zone.

The general field of waste-heat recovery has been surveyed by many engineers [1-4].[1] The possibilities for utilizing the energy in combustible refuse have been explored [5], [6], as an unusual area in which the fuel represented an unwanted commodity having, therefore, the aspect of a "negative-cost" fuel. Broad treatment of the waste-heat problem was also presented in two manufacturers' references [7], [8].

With the advent of better heat-resistant steels, metallic recuperators and regenerators were used in high-temperature service [15]. This trend has been significant, drawing upon the old idea of adding heat at the highest possible temperature [9], and making use of the improved over-all heat-transfer coefficients obtainable when the radiation film coefficients become large. An excellent presentation of the recovery of waste heat in industrial furnaces, waste-heat boilers, gas plants, and metallurgical processes, including considerable design and performance data, was published by the Institute of Fuel [10]. The utilization of waste heat for preheating combustion air, feedwater heating, and space heating has been reported widely [11], [13], [14], and in some cases has also been used for power generation [12]. In the case of metallurgical processes, waste-heat boilers have been applied ranging in size from a small pilot plant [16] to a large forced-circulation de-

Contributed by the Process Industries Division and presented at the Annual Meeting, New York, N. Y., November 30–December 5, 1958, of The American Society of Mechanical Engineers. Paper No. 58—A-167.

[1] Numbers in brackets designate References at end of paper.

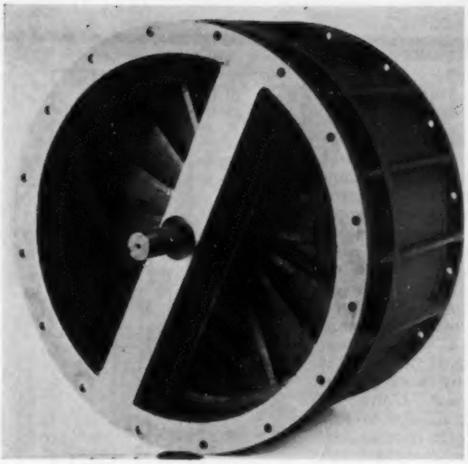
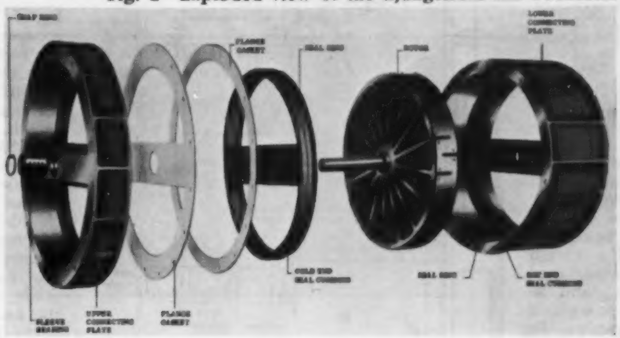


Fig. 1 Heat storage takes place in baskets of wire mesh instead of plate assemblies in the small Ljungstrom Air Preheater, designed with an 18-in. rotor diameter. The regenerator can handle air flows up to 2600 cfm, with a maximum hot-end temperature of 1000 F and 400 F maximum cold-end temperature. Estimated cross leakage is from 2 to 10 per cent.

Fig. 2 Exploded view of the Ljungstrom Air Preheater



sign [17]. This is an area where gas-turbine applications have also been suggested [18].

Apparatus

Perhaps the most widely known regenerative device is the Ljungstrom Air Preheater [19-24], in which a slowly revolving spider moves packages of metal plates alternately into a hot exhaust-gas stream and into a cold-air stream. The heat stored in the packages of plates, as a result of the passage through the hot gases, is given up to the cold-air stream effecting the preheating of the air. Regenerative devices are characterized by alternating flow of gases to be cooled and gases to be heated in the same passages, and by transient heat storage in the walls of the device. The metallurgical and ceramics industries have made extensive use of nonmetallic regenerators.

Although the Ljungstrom regenerator has not been widely adopted in the process industries, a new design appears to hold considerable promise. This unit, shown assembled in Fig. 1 and exploded in Fig. 2, was designed originally for naval use. The heat storage takes place in baskets of wire mesh instead of the traditional plate assemblies. The diameter is 18 in. and can handle air flows up to 2600 cfm (std. air), with a maximum hot-end temperature of 1000 F and a maximum cold-end temperature of 400 F. Cross leakage is estimated at between 2 and 10 per cent [48].

Extensive heat-recovery schemes have been built around the heat "losses" of the internal-combustion engine. Generally both the jacket cooling water and the exhaust gases are used. In some cases the warm jacket water is vaporized in a waste-heat boiler built around the exhaust piping [25]. While most installations are concerned with space heating, some process work has been done with engine heat [26], [29]. Both steam and hot water may be generated at the same time [27]. Jacket water temperatures have been maintained at 250 F without mechanical difficulties [28], and much higher temperatures have been used over short periods of time. Heat recovery for space heating has been used on engines as small as 38 bhp [30], and in some cases separate circuits have been used for recovering heat from the cooling water and from the exhaust gases [31], [32]. In one installation reported to the writer, heat is also recovered from the lubricating oil as well as from the jacket water and exhaust gases. On one 1000-bhp diesel engine, recovery of the heat energy in the cooling water and exhaust would double the fuel utilization [34]. Many cycles have been built around the application of gas turbines on waste-heat cycles [5], [33].

Recuperators constitute the class of heat exchangers in which there is a direct, continuous, and unidirectional flow of heat through a separating wall. They are built in a variety of designs and may be metallic or nonmetallic. Essentially they are steady-state heat-transfer devices in which air and/or gas absorbs heat from products of combustion. Many of the waste-heat installations in the metallurgical industries are equipped with recuperators. The modern trend is to greater use of metallic recuperators using either cast elements or welded sheets of high chrome-nickel steel [37], [38], [41–44], [50].

In most recuperators both the heating and cooling gases move at relatively low velocities. In order to improve the convection heat transfer, extended surface is sometimes used. A most interesting example of designing to take advantage of the convection and radiation components of the film coefficients is shown in Fig. 3. This is a waste-gas stack at a steel mill [51] in which the counterflow principle has been employed to preheat blast-furnace gas and air. A horizontal air recuperator is used to extract heat from the exhaust gases before they enter the stack. The air recuperator is 16 ft long with a diameter of 3 ft 3 in. It is made from 25 Cr-20 Ni steel at the hot end and from mild steel at the cooler end. The air-preheat temperatures range from 800 to 1100 F. The vertical blast-furnace gas recuperator is 40 ft long with a diameter of 2 ft 6 in., and both inner and outer shells are made of mild steel. The unit heats 80,000 cfh of blast-furnace gas to 900 F.

Another interesting recuperator designed for convective and radiant heating is shown in Fig. 4 [42]. The manufacturer claims that these units may be used for air or gas preheats up to 1562 F, and with waste gases up to 2732 F. A bayonet-type recuperator element is shown in Fig. 5 [43], [44].

Several attempts have been made to increase gas velocities in a manner which would effect the displace-

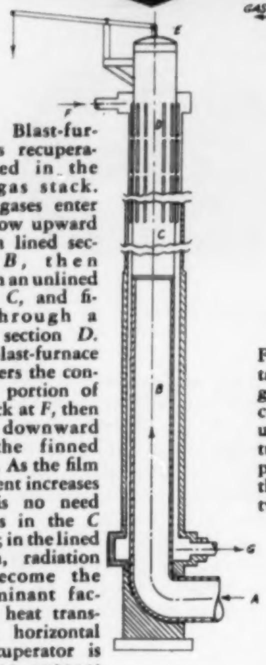


Fig. 3 Blast-furnace-gas recuperator used in the waste-gas stack. Waste gases enter at *A*, flow upward through lined section *B*, then through an unlined section *C*, and finally through a finned section *D*. Cool blast-furnace gas enters the concentric portion of the stack at *F*, then flows downward over the finned section. As the film coefficient increases there is no need for fins in the *C* section; in the lined portion, radiation has become the predominant factor in heat transfer. A horizontal air recuperator is used to extract heat from the exhaust gases before they enter the stack at *A*.

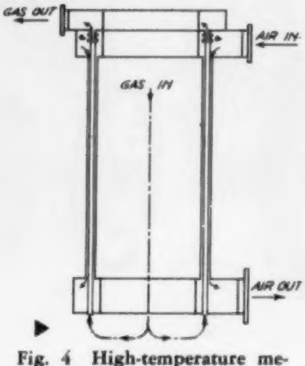


Fig. 4 High-temperature metallic recuperator in which hot gases pass downward in the center of a ring of tubes, then upward through concentric tubes. A higher velocity is imparted to the air by restricting the flow path to the space between the concentric tubes.

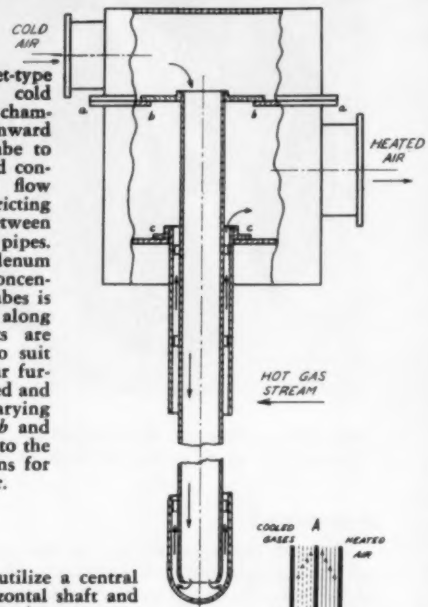


Fig. 5 In the bayonet-type recuperator element, cold air enters a plenum chamber, then flows downward through the inner tube to the bottom of a closed concentric tube. Return flow is accelerated by restricting the passage area between the two concentric pipes. Heated air enters a plenum chamber at *C*. The concentric position of the tubes is maintained by spacers along the flow path. Units are made up in banks to suit the needs of particular furnaces. Tubes are welded and can be furnished in varying lengths. Flanges at *b-b* and *c-c* permit easy access to the individual tube sections for replacement or repair.

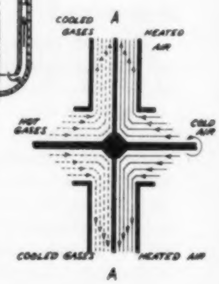


Fig. 6 Motala fan recuperators utilize a central disk *A-A* revolving about a horizontal shaft and flanked by two other disks, each having an opening concentric with the shaft and constituting two impellers back to back. Cold air is moved radially outward on the right side and hot gases move in parallel fashion on the left side. As the two gas streams move outward, heat is transferred through the disk *A-A*, so that air leaves the unit at higher pressure and higher temperature. Units are built up in sections with alternating gas and air passages.

ment of the fluid and improve the heat transfer. Linderoth [45], [46] patented devices in which the functions of induced and forced-draft fans were combined with air preheating, and at least one American firm undertook experimental work with these units [48].

In Sweden, the Motala fan-preheater is reported to be in successful operation in a number of installations. This unit is shown schematically in Fig. 6. It is credited to Vannerus [47], [52].

An important technique for exploiting energy in waste gases is to return a portion to the entering air-gas mixture in the furnace. This *recirculation* has many advantages in that less capital investment is required and the plant is less complicated. Also, it can be effective in cases where the temperatures are too low to make recuperation attractive. The limiting factors are stoichiometry and the danger of preignition. A heat balance on a galvanizing furnace has been reported [59].

The growing use of catalytic combustion has offered some interesting opportunities for heat recovery [60]. In areas where organic fumes are generated in large volume, it is possible to oxidize them over a catalyst with a liberation of heat as the fumes are broken down to carbon dioxide and water vapor. This catalytic combustion is accomplished with only modest preheat to bring the gas mixture to the lower ignition limit. A typical circuit involving heat recovery and recirculation is shown in Fig. 7.

Of the many examples of heat recovery from solids, the cement industry has offered some outstanding ones [54]. In fact, it was pointed out many years ago that the heat from cement kilns was sufficient to run the entire mill [55]. An interesting recuperator for preheating the incoming gas and air in a rotary kiln is shown in Fig. 8 [49].

In Fig. 9 another Swedish heat-recovery scheme is shown in which a liquid acts as "vehicle" [39]. A solid-vehicle system, Fig. 10, is an experimental unit in an industrial laboratory [48]. Another company [8] reports that a similar unit using mullite spheres has preheated air to 2300 F.

Discussion

Each waste-heat recovery scheme must be considered in terms of the processes involved, the cost of fuel, and the uses to which the heat or equivalent energy can be put. It is difficult to generalize on this subject, but certain features stand out which will serve to indicate a trend:

1 Many years ago Gerbel [58] found that only six out of 31 industries could balance process-steam re-

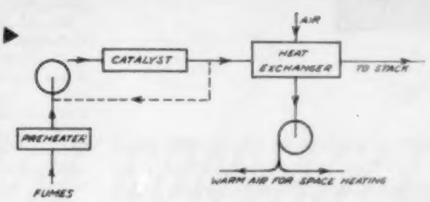


Fig. 7 Where organic fumes are generated in large volume it is possible to oxidize them over a catalyst with a liberation of heat as the fumes are broken down to CO_2 and water vapor. This catalytic combustion is accomplished with only modest preheating of the collected fumes. The dotted connection shows a recirculation line which could be used to bring part of the hot products back to the fan intake. A heat exchanger provides warm air for space heating.

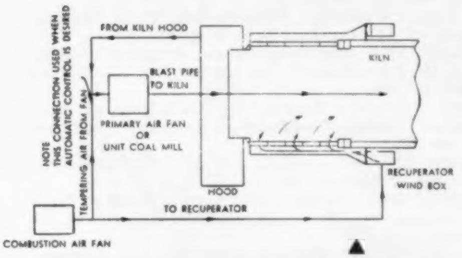


Fig. 8 A solid acts as the "vehicle" in a rotary-cement-kiln recuperator which heats the incoming gas and air in the rotary kiln. Clinker moves to the left over a series of wind boxes, and as the clinker is cooled the heated air rises into the combustion space in the kiln.

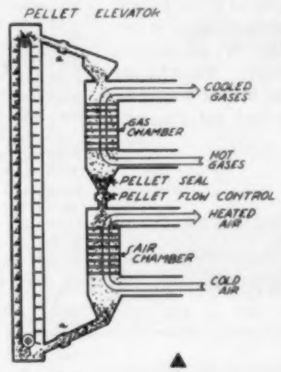


Fig. 10 An experimental unit in an industrial laboratory introduces small pellets into a gas chamber where they fall through a matrix of wires, countercurrent to a stream of hot gases. Heat is absorbed by the pellets which pass through a flow-control device and into a lower chamber. Here again, the pellets flow down over a matrix of wires, only this time they give up heat to a rising stream of cold air. The conical sections at the ends of the two chambers form gas-tight seals; an elevator returns the pellets to the upper chamber. It is reported that air temperatures up to 2000 F have been produced in this manner.

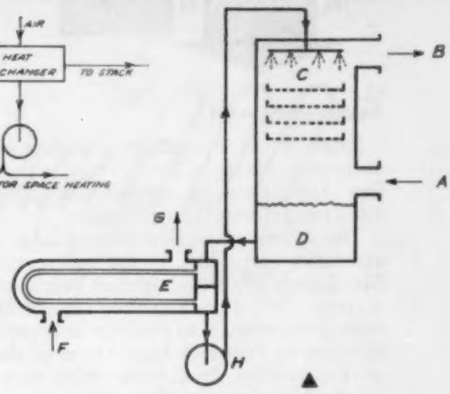


Fig. 9 Liquid acts as the "vehicle" in another heat-recovery scheme where hot gases enter a spray chamber at *A* and leave at *B*. Heat is given up to a liquid circulated by the pump *H*. The liquid spray at *C* cascades over trays in the main chamber, removing heat from the gases. The heated liquid is collected at *D* and run through a heat exchanger at *E*. The fluid to be heated is then raised in temperature between *F* and *G*.

quirements with power requirements. He took as his yardstick 6-16 times as much steam as horsepower-hours per unit of product. An excess of steam or of power was found in each of the remaining 25 industries.

2 With the great improvements in central-station heat rates, purchased power has in most cases become more economical than that generated in industrial power plants. A large utility recently showed that purchased power would be cheaper than that obtained from process steam as a by-product in a 2000-kw turbine, and about the same as from a 5000-kw by-product operation.

3 In terms of return on investment the industries can show more profit from operation of improved manufacturing or process equipment than from power-generating equipment.

4 Power generation from the incineration of refuse has made no significant progress over the last decade, in spite of the fact that fuel was available at no cost.

5 Elaborate waste-heat utilization systems involving thermal cascading [36] or multiple-recovery cycles [35] or very unusual apparatus [57] will find less justification in the future. The costs of installing, operating, and maintaining such equipment will offset the potential savings.

6 Important progress can be made in waste-heat utilization where the improvements can be made in the basic process. The metallic recuperators are examples of devices that have great process potential.

7 West [56] has suggested that waste heat should always be used for space heating, but cautions that unless the salvage plan can show a return of at least 10 per cent over and above carrying charges it is not attractive.

8 The new vehicle types of heat-transfer equipment may have an important impact upon the process industries. It is probable, however, that they will be considered as part of basic processes rather than as heat-recovery devices.

9 There are many areas where heat-recovery equipment is not justified but where improvements in the process could be effected by recirculation of part of the waste gases.

Conclusions

1 There will be fewer waste-heat cycles in which power generation is a by-product.

2 Where energy can be returned to the process, whether in primary or secondary stages, greater heat-recovery effort will be made.

3 The trend is to simpler apparatus and to equipment that can take advantage of higher temperatures.

Acknowledgment

Some of the equipment described in the paper was uncovered during a literature search for the American Gas Association on recuperative and regenerative devices for gas-burning equipment.

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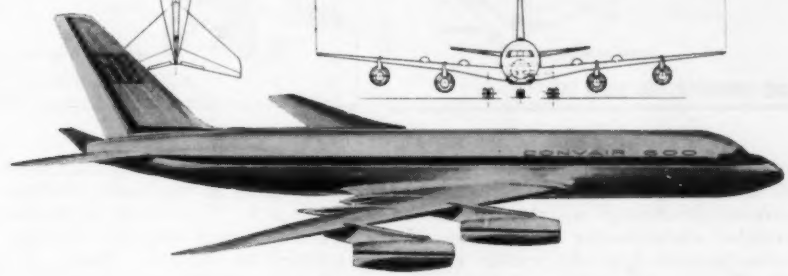
THE CONVAIR "600" Jet Transport



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San Diego, Calif.

Design and operation of certain systems and subsystems of the "600"— and the precautions taken to insure continuing function of each system

The Convair 600, which is powered by four General Electric CJ-805-21 aft-fan turbojet engines, carries up to 121 passengers, on routes up to 3000 miles, at speeds in excess of 10 miles per min. The aft-fan engine is a modification of the conventional turbojet engine to which an annular air-intake duct and a free-wheeling turbine-compressor combination have been added. The aft-fan increases the thrust for take-off by approximately 35 per cent, reduces the specific weight by 9 per cent, and results in a reduction in the specific fuel consumption of between 10 and 18 per cent at cruising speeds. In addition, the noise level of the aft-fan engine is lower than that of most other jet engines equipped with noise suppressors.

The high earning potential of the high-speed jet airplane—a predictable use factor of 5-to-12 ratio over the conventional piston-engine equipment—makes it imperative that all the systems and units be engineered and located so that they are readily accessible and can be maintained and serviced with the least possible interference with flight utilization.

In the Convair 600, only two engines are needed to keep the airplane aloft; four generators supply electric current for over a dozen different needs; an elaborate fuel system insures a steady flow of fuel to the engines; duplicate, and in some cases triplicate, electronic gear fills the communication and navigation demands; fail-safe flight controls are guaranteed by a combination of hydraulic, electrical, and manual operation; and passenger comfort at all altitudes is maintained by an elaborate pressurization and air-conditioning system.

Flight Control Systems

Elaborate precautions have been taken to make sure that any failure in the control systems will not jeopardize flight safety. The pilots' controls are connected mechanically with the flight tabs on all three sets of primary controls, and the stabilizer can be adjusted manually in an emergency. The flaps and slats have dual sources of hydraulic power; and, even if both systems should fail, the pilot can proceed to an airport where he can make a safe landing without them.

Ailerons. The pilots' control wheels are connected mechanically with the tabs on the aileron surfaces by cables and push-pull rods. These connections pass through the aileron/spoiler mixer where the aileron action is transferred to the hydraulic valves which operate the spoilers.

When the speed-brake lever is in the closed position, the spoilers lie flush with the upper surface of the wing of which they form a part. Rotation of the control wheel lowers one aileron and raises the other one. The mixer will transfer this aileron action to the spoiler system and will raise the spoiler adjacent to the raised aileron. With the spoilers in the full-open position, the aileron action will be augmented by the downward movement of the spoiler on the side of the lowered aileron. With the speed-brake lever in any intermediate position, the

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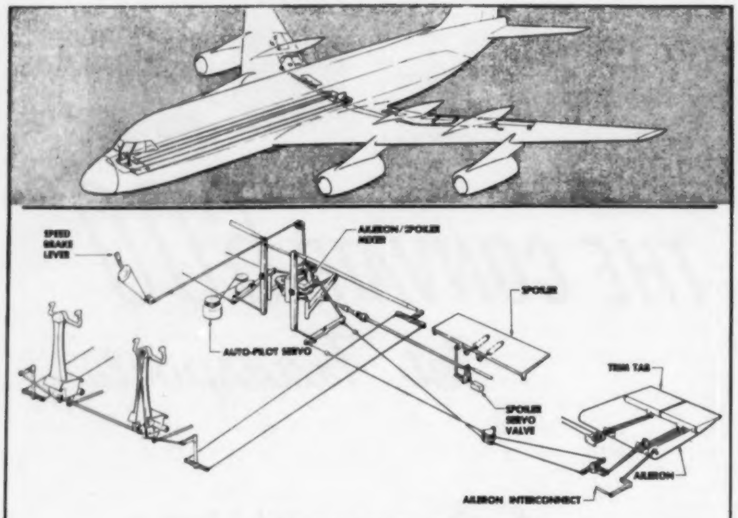
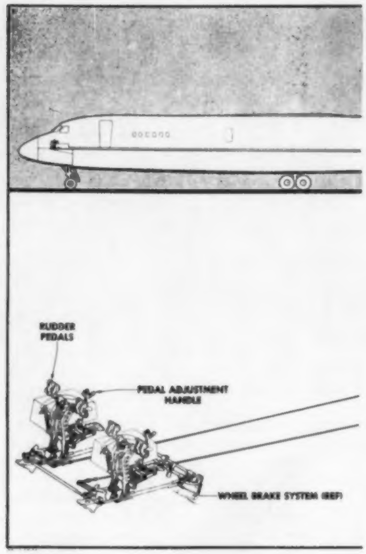


AILERON AND SPOILER SYSTEMS FLIGHT TAB



spoilers will move up and down in unison with the ailerons and increase their effectiveness in banking.

Rudder. The rudder pedals are connected through a system of cables, push-pull tabs, and bell cranks to the rudder flight tabs in such a way that pressure applied to the right pedal moves the tab to the left, which in turn swings the rudder to the right causing the airplane to turn to the right.

A boost hydraulic system connects the rudder linkage to standard horns attached to the rudder. During normal flight operations, rudder movement is controlled by the flight tabs through direct mechanical connection with the rudder pedals. However, excessive rudder-pedal movement activates the hydraulic pressure-regulating valves and allows fluid to flow into the rudder-actuating cylinders and augment the action of the rudder tabs.

Elevators. The elevators are equipped with flight tabs. Movement of the pilot's and copilot's control columns is transmitted to tabs through a mechanical linkage. There is no hydraulic boost to this system, and no trim tabs are provided. Longitudinal trim is accomplished through the adjustable stabilizer.

Adjustable Stabilizer. The stabilizer is attached to the fuselage by a single forward and two rear hinged mounts. The forward mount attaches through an adjustable mechanism that can be used to raise or lower the leading edge.

The adjusting mechanism consists of a nonreversible nut and screwjack arrangement. The nut is hydraulically driven and is contained in a housing attached to the stabilizer. The screwjack is attached to the fuselage through a mounting which includes a set of bevel gears. The position of the leading edge of the stabilizer in relation to the fuselage can be varied by rotating the nut, or by means of the bevel gears which can be used to rotate the screwjack. Either way, the stabilizer can be set at any angle between 2 deg up and 14 deg down in relation to the longitudinal axis of the airplane.

Four stabilizer trim wheels are provided, two mounted on each side of the control pedestal. The upper wheels are connected through cables to the follow-up mechanism which ports hydraulic pressure to the motor that rotates the nut on the screwjack. The follow-up mechanism shuts off the hydraulic motor when the stabilizer reaches the setting selected by the trim wheel. The stabilizer will stay in the selected position because of the irreversible feature of the nut-screwjack design. Turning the trim wheels also controls the trim indicator which gives the flight crew the trim setting.

For emergency trim, if the hydraulic system should fail, a 200-volt, a-c, 3-phase motor is connected to the bevel gears attached to the screwjack. Turning the screwjack has the same trimming effect as rotating the hydraulically driven nut.

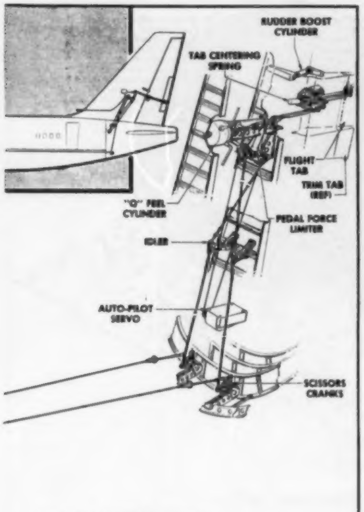
If the electric system should fail, the pilot or copilot can rotate the bevel gears manually by means of the lower pair of trim wheels.

Auxiliary Flight Control Systems

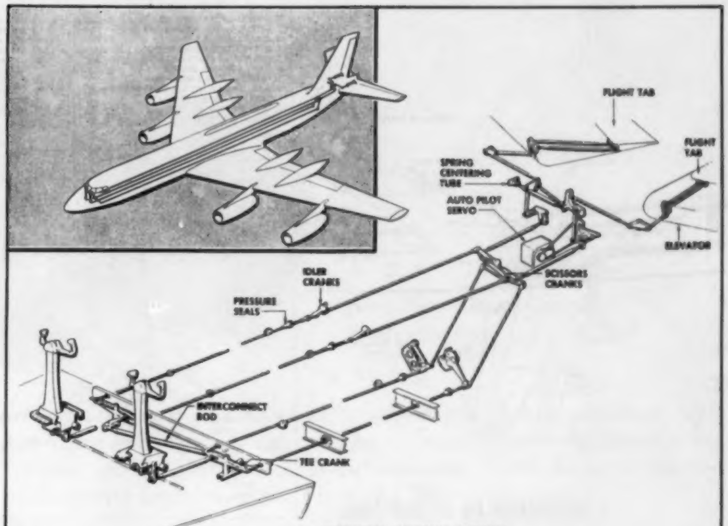
Two means are provided to reduce the landing speed of the Convair 600. Both wing flaps and leading edge slats are utilized. The spoilers previously mentioned do not decrease the landing speed but add materially to the drag and thereby allow a steeper descent.

Wing Flaps. The wing flaps, two on each wing, form the trailing edge inboard and for a short distance outboard of the two engines. They are double-slotted Fowler flaps supported by steel tracks attached to the rear spar. The flaps are extended and contracted by screwjacks connected to two hydraulic motors through a system of torque tubes, universal joints, and gearboxes. The motors are driven by separate hydraulic systems, and one motor will operate all the flaps at a reduced speed. If an asymmetric flap condition should develop, shut-off units will cut off the hydraulic pressure to the flap motors.

Leading Edge Slats. The leading edge slats, four to each wing, are located along the leading edge, with two of them between the two engines and the other two beyond the outboard engine. When closed, they conform to the



RUDDER CONTROL SYSTEM



ELEVATOR CONTROL SYSTEM

contour of the wing; but in the open position they modify the air flow over the wing and reduce the stalling speed.

The Cabin

The Convair 600 was designed to operate at altitudes up to 40,000 ft where the temperature is frequently far below zero and the density of the atmosphere is less than one fifth of what it is at sea level. Even so, the passengers and crew ride in an environment comparable to an air-conditioned home located at a comfortable altitude of 8000 ft.

The air-conditioning equipment will provide any desired temperature between 65 and 90 F throughout all anticipated operating temperature extremes. The pressurizing equipment will maintain sea-level pressure in the cabin and crew compartments at all altitudes up to 21,000 ft. Above that altitude, the inside pressure will gradually decrease until it is reduced to an 8000-ft equivalent pressure when the airplane reaches an altitude of 40,000 ft, the maximum design altitude.

The plane is equipped with a dual air-conditioning and pressurization system composed of two independent parallel subsystems, either one capable of meeting the normal temperature and pressure requirements.

Pressurization. Compressed air for pressurization is provided by two separate air-driven turbocompressors. Each unit combines a turbine and a centrifugal compressor mounted on a common shaft. The turbines are driven by bleed air, which is drawn from the 17th compression stage of the four turbojet engines and directed against the turbine blades through variable-area nozzles.

Controls and indicating devices are provided to maintain proper air-weight flow, turbine speeds, and temperature as demanded by the temperature-control system. Pressure-regulating valves installed in the engine manifolds reduce the pressure of the bleed air to 40 psig and provide a means for shutting off the bleed air entirely.

The output of the turbocompressor is maintained at the desired level by a flow-control device which controls the opening in a variable-area nozzle. When additional heat is required, a heat-control modulating valve diverts a portion of the compressed air back to the compressor inlet and recirculates it through the compressor to increase its temperature.

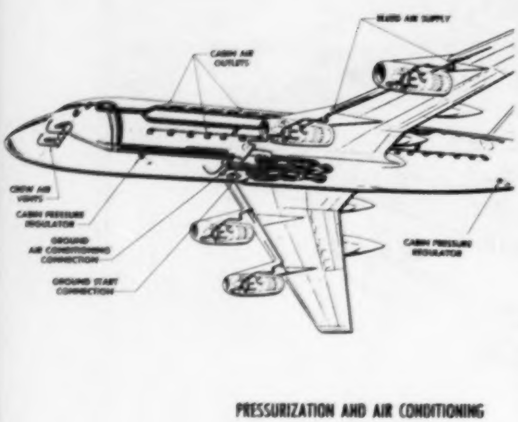
The pressure within the cabin and crew compartments is controlled by two pressure-regulating outflow valves which allow air to escape at a rate that will maintain the desired pressure differential between the inside and outside air. One of the outflow valves is located in a pressurized area at the aft end of the fuselage; the other is vented through a plenum chamber containing the electrical equipment and aids in cooling this compartment. Either of the outflow valves is capable of maintaining the selected cabin pressure.

The maximum pressure differential under normal operating conditions is slightly over 8 psi. The outflow valves are fail-safe in the closed position; but, should they both fail, safety valves incorporated in the outflow valves will open to relieve the pressure when it reaches $8^1/_2$ psi.

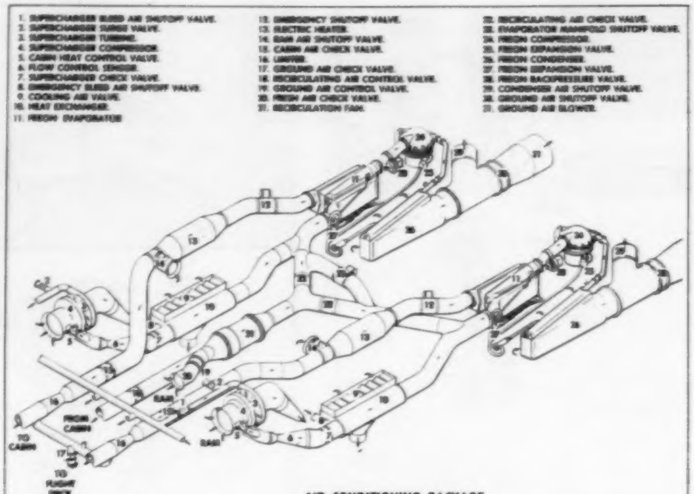
Refrigeration. The Freon cooling systems contain closed vapor-cycle refrigerators. Two identical units are installed, either of which is capable of providing all the cooling required for normal operation.

Fresh outside air for the air-conditioning and pressurization system enters two ram-air inlets, one located on each side of the fuselage, and passes into a plenum chamber. From there, the air passes through the turbocompressors which increase its pressure and temperature. A heat-control modulating valve recirculates a portion of the compressed air through the compressor when additional heating is needed.

From the turbocompressors, the pressurized air passes through ducts to heat exchangers which reduce the temperature of the air. The conditioned air passes through ducts to the cabin and flight-deck distribution lines and outlets. About one tenth of the conditioned air is supplied to the crew compartment. Air enters the cabin through slots located above every second window



PRESSURIZATION AND AIR CONDITIONING



AIR CONDITIONING PACKAGE

and through "piccolo" openings above each passenger seat.

The operation of the pressurization system is controlled automatically through a cabin-altitude selector and a rate-of-change knob. The temperature is regulated by a variable rheostat, or it may be controlled manually by "hot" and "cold" momentary positioning switches.

Hydraulic Systems

Two independent hydraulic systems are employed at a pressure of 3000 psi.

System No. 1 is connected to the pumps on engines No. 1 and No. 2. The No. 2 hydraulic system is connected to the pumps on engines No. 3 and No. 4. Some of the aircraft components depend on system No. 1, others on No. 2, while still others are powered by both systems.

The only direct connection between the two systems is through the reservoir arrangement. The reservoirs are connected at the refill level so that a leak in one system cannot drain the other reservoir below a safe operating level. Both systems have a common manual and remote-fill connection, but each has its own ground-test return and ground-test pressure connection.

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High-Pressure Pneumatic System. Normally the engines are started by air-turbine starters using compressed air supplied by an air-compressor cart stationed at each air terminal. When one engine has been started, the other engines can be started using bleed air from the running engine.

If no ground equipment is available, the Nos. 2 and 3 engines can be started using compressed air stored aboard the airplane in air-storage flasks. These flasks are charged during flight by a hydraulic-driven air compressor, or they can be charged on the ground using the compressor cart. Air from the flasks is fed under high pressure through in-line combustor to the air-turbine starters.

Fire Detection and Extinguishing. The fire-detection system is a 28-volt, d-c, two-loop continuous circuit that provides cockpit indication of an overheat condition in the engine accessory compartment, in the engine pylon, or in the turbine compartment of each engine. Dual lights on the engine-isolation control handle in the flight compartment illuminate when a hazardous condition exists in a particular engine installation. A steady light indicates a fire or excessive temperature in the pylon or engine accessory compartment; a blinking light indicates that safe temperature limits have been exceeded in the turbine compartment.

Two independent, high-rate-of-discharge, "two-shot" fire-extinguisher systems are provided to protect the engine installations. A fire-extinguisher bottle containing bromotrifluoromethane (CF_3Br) is located in each engine pylon. The bottles in the Nos. 1 and 2 engine pylons are interconnected in such a way that either bottle can discharge into the compartments of both engines. The same is true for the bottles in the Nos. 3 and 4 pylons. With this arrangement, one bottle can be used as a "first shot" and if the fire persists the second bottle can be discharged into the same engine. Each bottle contains sufficient fluid to dilute all the atmosphere within and entering a compartment for a time period sufficient to extinguish a fire.

Oxygen System. A high-pressure, 1800-psi, gaseous oxygen system is installed for emergency use by the passengers and crew. Lightweight steel cylinders supply oxygen to the regular oxygen-distribution system, and portable bottles are placed at strategic points.

The oxygen system for the flight crew, which utilizes one of the cylinders, is a diluter-demand type; the passenger system is the continuous type.

One oxygen mask is available for the occupant of each passenger seat, and additional masks are provided for an observer, for each cabin attendant, and for each lavatory.

An automatic release valve will start the flow of oxygen to the passenger oxygen system if the cabin pressure should drop to the equivalent of a 16,000-ft altitude. When oxygen is introduced into the passenger system, the pressure operates pneumatic latches opening the mask storage panels above the passengers and allowing the masks to drop down to within easy reach.

Viscoelasticity in Lubrication

By G. J. O'Donnell
Shell Development Company,
Emeryville, Calif.

We need to know how viscoelasticity is involved in such mechanisms as high-speed gears and bearings. We need to know under what conditions various fluids display viscoelasticity. This information could have immediate value in designing high-speed machines and their lubricants.

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Under these high loads it has been shown that plastic flow can take place on spur-gear teeth. Pressures as high as 5×10^5 psi obtain, yet radioactive studies [1][1] on gear teeth have shown that lubricants can prevent metal-to-metal contact even under such conditions. It has been hypothesized that the viscoelastic properties of the lubricant and hence its concomitant "relaxation time" are part of the explanation.

Information at Hand

What is already known? First, we had better define viscoelasticity, since it is not in the dictionary. In 1867, Maxwell [2] predicted from a theoretical model of the liquid state that if a liquid were stressed rapidly enough it would show an elastic response to the stress. In other words, depending on the rate of application of a shear stress to a liquid, the shear response could be that of a normal viscous liquid or of an elastic solid. Or, if it responded as a combination of both, it would be what is known as a "viscoelastic" substance.

Maxwell's prediction has by now been proved not only for liquids but even for air [3], if the rate of stressing is high enough. In stressing a viscoelastic material, mechanical energy is partly stored in the form of potential energy in the substance and partly dissipated as heat. Such behavior is known as "viscoelastic behavior."

Viscoelasticity is familiar, even if not by that name. The metallurgist refers to it as "anelasticity" and "creep." If a block of metal is deformed within its elastic limit, and the stress removed, the metal will regain its original shape. However, if the stress is applied for several centuries, the metal will take on a permanent deformation. If a rubber band is stretched and the stress removed, the rubber band regains its former shape. However, if the rubber band is held in its stretched form for several months, flow takes place, and the rubber band is permanently deformed. Hence one can see that time enters into this somehow. Perhaps the clearest explanation of how time enters into viscoelastic behavior is that given by Alfrey [4].

Consider a material which will undergo an instantaneous elastic response when stressed, but which can also flow. The total deformation ϵ of such a material under shear stress is the sum of its elastic deformation and its flow. The elastic deformation is simply $(1/G)\,\sigma$ where G is the shear modulus and σ is the stress at time t. The flow deformation, however, depends not only on the stress, but upon the duration of the stress. Hence we can only say that the instantaneous *rate* of flow is given by $(1/\eta)\sigma$ where η is the viscosity. Consequently, an explicit expression relating the deformation with the stress is not possible. We can, however, derive an expression giving the rate of change of the deformation.

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This merely states that the total rate of change of the displacement is given by the rate of flow plus the rate of change of the elastic part of the deformation. This is the fundamental differential equation which governs the

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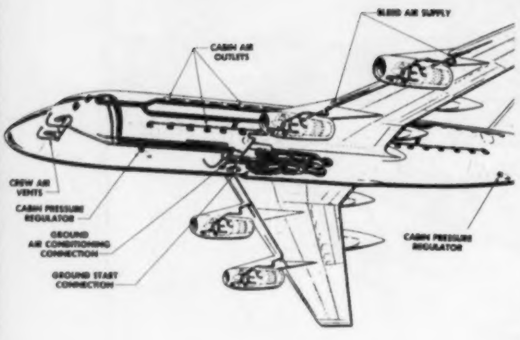
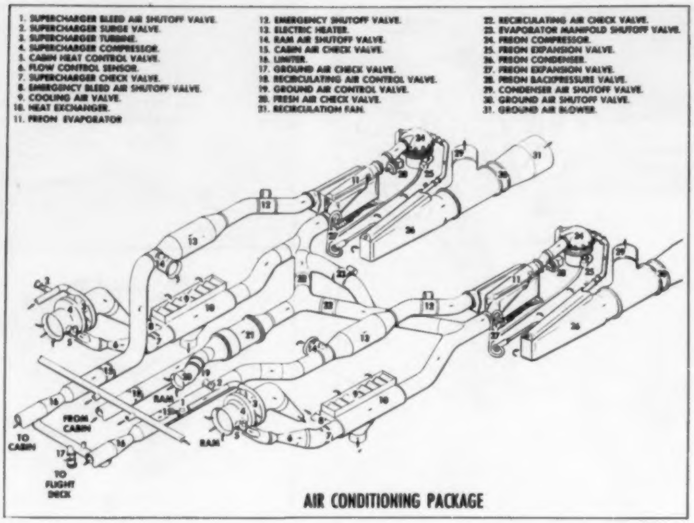


PRESSURIZATION AND AIR CONDITIONING



AIR CONDITIONING PACKAGE

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mechanical response of the material not only to a constant shear stress but to any sequence of shear stresses and to any sequence of constraints upon the deformation itself.

Both Elasticity and Flow

An example: If one rapidly deforms a sample exhibiting both elasticity and flow and then constrains it so that it must retain this deformed shape, the internal flow gradually relaxes the stress. Since $d\epsilon/dt = 0$, our equation reduces to

$$\frac{1}{G}\frac{d\sigma}{dt} + \frac{1}{\eta}\sigma = 0 \tag{5}$$

which has a solution

$$\sigma = \sigma_0 e^{-\left(\frac{G}{\eta}\right)t} \tag{6}$$

Thus the stress relaxes exponentially with time. After a time equal to η/G, the stress will have decayed to $1/e$ of its original value. The ratio η/G is consequently called the "relaxation time" for the material and is represented by the symbol τ.

The behavior of a material exhibiting flow superimposed on elasticity can be represented by the mechanical analog of a spring and dashpot in series. It can just as well be represented by creep functions, mechanical impedance functions, operator equations, or rate equations depending on which discipline one finds most convenient. Returning to our spring and dashpot—when the stress is applied, the spring immediately stretches by the amount σ/G and the dashpot elongates steadily at the rate σ/η. When the stress is removed, the spring instantaneously contracts, but the dashpot remains where it is.

The relative importance of these responses obviously depends not only on the magnitude of G and η, but also on the time scale of the experiment. If the stress acts for a time T, the magnitude of the elastic deformation is σ/G, and for the flow deformation $(\sigma/\eta)T$. If T is very small compared to η/G, then the elastic deformation will completely overshadow the flow, and the material can be considered an elastic body. If T is very large compared to η/G the flow will overshadow the elastic response and the material would be considered a simple Newtonian fluid. Only if T is the same order of magnitude as η/G is the composite nature of the deformation apparent.

For real materials, which exhibit a whole spectrum of relaxation times, a single Maxwell model of a spring and dashpot in series will not suffice. For these, one must use an entire series of them, arranged in parallel.

Molecular Behavior

On the molecular level, what are the mechanisms that can be assigned to the springs and dashpots? The existing molecular theories are so crude that they give a very qualitative and tentative mechanistic interpretation to the elements of the phenomenological model. In some cases, however, we can relate the relaxation time to the chemical kinetics of a definite, specified chemical reaction.

As a general example, consider the shearing of an oil solution of polymer molecules. There are many different kinds of forces holding molecules together, and each of these affinities have different rates of breaking and reforming. Consequently, you have a distribution of relaxation times. To the spring elements we can assign the stretching of primary valence bonds; pulling chains away from neighbors; opening up valence angles; straightening out kinks, curls, convolutions, and entanglements of the polymer molecules; twisting bonds against the hindering potential which interferes with free rotation, etc. All these store energy, so to it must be added the decrease in entropy when shearing restricts the polymer chains to less probable configurations. To the dissipative function, or dashpot, we ascribe those irreversible reactions, such as breaking chemical bonds, van der Waals' bonds, dipole-dipole interactions, hydrogen bonds, and labile covalent bonds; slippage of polymer chains past one another; and the other things that go to make up the normal viscosity of the oil itself.

Returning to our equation

$$\frac{d\epsilon}{dt} = \frac{1}{\eta}\sigma + \frac{1}{G}\dot{\sigma}$$

there are a few things to be pointed out. This equation applies only to a linear system with one degree of freedom. Furthermore, η is a function of the shear rate for non-Newtonian fluids, and typical viscoelastic fluids are all non-Newtonian. (In the ultimate analysis, there are no Newtonian fluids.) This in turn will affect the relaxation times. Consequently, we are very much in need of data on the properties of oils under high rates of shear, their relaxation times, etc. Although such data are available for many polymers, very little is known about oil per se.

If, in the case of our spur gear machine, the oil has a relaxation time of the same order of magnitude as the contact time, then one can see that the lubricant will act as an elastic solid and hence carry a load much greater than that predicted from hydrodynamic theory. In other words, the oil would act like a spring instead of flowing out from between the gear teeth. It would also explain the increase in load-carrying ability at increasing speeds, if these speeds yielded shear rates of the same order of magnitude as the relaxation times.

The time scale involved in high-speed operation of ball bearings as well as spur gear machines can be of the order of 10^{-6} sec. We have little data on relaxation times of mineral oils, silicones, diesters, or other fluids of about one-poise viscosity, although theory predicts that they are of the order of 10^{-6} to 10^{-8} sec. Increasing pressure or temperature could change this but would increase the difficulty of measurement.

Cross Stresses: Cross Viscosities

The discussion up to this point has involved only a single stress and its associated displacement. However, in most applications several stresses are involved. As it happens, most of the time these produce cross stresses and cross viscosities. These can best be handled by the nonlinear mechanics of Reiner [5, 6].

Before going further, some mention should be made of what is meant by linear and nonlinear theory. Materials which obey linear theory are such that two stresses applied simultaneously produce the same effect as the

same two stresses applied consecutively. For example, a material for which the linear theory is adequate will be deformed in the same manner if it is sheared and compressed simultaneously, or if it is first sheared and then compressed. On the other hand, for materials which require the application of a nonlinear theory, the result will depend on the order in which the operations are carried out. For example, material conforming to nonlinear mechanics will generally expand if sheared without the simultaneous application of a compressive force.

The nonlinear theory is required for treatment of any material, whether fluid or solid, where internal forces arise in response to a strain. Although Reiner has shown that these cross stresses arise even in materials showing bulk elasticity, they are of a larger order of magnitude in those materials showing shear elasticity. A familiar example of behavior explained by nonlinear theory is that of twisting a rod. It had been long known experimentally that, on twisting an elastic rod slightly, it will elongate proportionally to the square of the angle of twist. Swift [7], for example, has shown that in plastic torsion, rods made of steel or copper lengthen, but those of lead shorten.

Another illustration of cross terms which are dealt with by nonlinear theory may arise when a fluid is rotated about a fixed rod. With a primarily Newtonian fluid, the centrifugal action forces the liquid against the outer walls of the container. With a viscoelastic material, however, the fluid will climb up the rod, and the force required to prevent such a rise is proportional to the square of the rate of rotation.

In the paint industry, for example, rotary stirrers were found essentially useless because the paint climbs the stirrer. Most wives are familiar with a similar effect when trying to mix dough with a rotating stirrer. It is probably more germane to our field to remark that a conventional 10W30 motor oil will climb a shaft rotating at a critical speed under certain pressures. However, this is a minor effect inasmuch as a 10W30 oil is very slightly viscoelastic.

These viscoelastic fluids in climbing the rotating shafts are displaying the force normal to the direction of shear required by the nonlinear theory. This particular effect is called the "Weissenberg effect" after one of its more prominent investigators. For a most lucid discussion of the subject of normal stresses in viscoelastic fluids, see the paper by Philippoff [8].

Load-Carrying Capacity

Now to hypothesize how some of these properties inherent in a viscoelastic lubricant will affect the load-carrying capacity (l.c.c.) of a very high-speed, heavily loaded journal bearing:

The lubricant is circulated by the rotation of the bearing and can be periodically subjected to very high rates of shear as it passes through the narrowest clearance. The viscosity of most viscoelastic materials decreases with increasing shear rates. In addition, there may be some permanent lowering of the viscosity of the fluid because of degradation due to shear and/or cavitation. Inasmuch as the l.c.c. of a journal bearing is, according to hydrodynamic theory, determined by the viscosity of the fluid, these factors tend to lower the l.c.c. During the rotation of the bearing, the fluid carried through the narrow region is subjected to a periodic stressing. If this period is of the same order of magnitude or less than the relaxation time, the l.c.c. should be increased, since the lubricant will act like an elastic solid. Similarly, the normal force, or Weissenberg effect, increases at high rates of shear, and therefore it also should increase the l.c.c.

This has been a brief discussion of some of the more obvious aspects of viscoelasticity. It has not included such aspects as the decrease in entropy during shearing, and the effects of pressure and temperature on the properties of viscoelastic lubricants. The mathematical complexities have been glossed over, but mention should be made of the experimental implications.

The experimental problems associated with the determination of relaxation times are considerable. At atmospheric pressure and ambient temperature the relaxation times will generally be less than a microsecond. This in turn means that the experimental equipment designed to measure relaxation phenomena must operate near the megacycle region. To do this involves the delicate experimental techniques of Mason, McSkimmin, and others at the Bell Telephone Laboratories, or some ultrasonic technique. Furthermore, extremely high temperatures and pressures are frequently involved in actual lubricating processes. These in turn can change the viscosity and the shear modulus and hence the relaxation times. Considering the temperatures and pressures involved, it is apparent that the experimental difficulties are compounded.

Before we can start considering the phenomenon of viscoelasticity in the design of high-speed machines we need these basic data. And not only do we need the viscosities and relaxation times at high temperatures, high pressures, and very high rates of shear, but we also have to know how these factors influence both boundary and hydrodynamic friction.

Where Do We Start?

Inasmuch as the foregoing represents an inordinate expenditure of effort, a few preliminary scouting experiments are required. First, a few polymeric solutions should be examined in order to find some with a relaxation time of the order of magnitude germane to the stress periods experienced in machines. Further, in order to insure that the viscoelastic properties will not be lost in actual operation involving high rates of shear, one must be selected with minimum viscosity-shear sensitivity. Then, and only then, can engineering experiments be designed to see to what extent viscoelasticity can be a contributory factor in the performance of machine elements.

If it is established that viscoelasticity plays an important role in lubrication, then the acquisition of large amounts of basic data is not only justified, it is practically imperative.

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1957

Progress in Railway Mechanical Engineering

1958

Although the production of locomotives and cars over the past year was not as high as in some previous years, there has been lively activity on the part of builders in developing new models, particularly diesel-powered locomotives.

The distribution of motive-power type in the United States, as of July 1, 1958, is shown in Table 1.

The number of diesel units owned or leased increased by 678 units in the past 11 months, whereas the number of steam locomotives decreased by 1300.

Locomotive Development Activities

United States builders of diesel-electric locomotives have continued to build essentially standard locomotives. European builders brought out a variety of models, many of which made use of hydromechanical transmission.

One of the 8500-hp gas-turbine-electric locomotives built by the General Electric Company for the Union Pacific Railroad, Fig. 1, has a total weight of 816,000 lb, not including tender, on 12 driving axles [2].[1]

General Motors built for demonstration on the Duluth, Missabe & Iron Range Railway a new 2400 (net)-hp locomotive, designated SD-24. This locomotive is similar to the SD-9 except that it has a turbosupercharged engine, and the control is all-electric [19].

Although there has been very little development activity in steam-locomotive design for many years, the manufacture of steam locomotives continues, notably at the plant of Beyer, Peacock & Company, Ltd., in Britain. One of an order of 60 Beyer-Garratt type steam locomotives for the South African Railways is shown in Fig. 2.

The feasibility study of atomic-powered locomotives jointly undertaken by the Denver and Rio Grande Western Railroad and the Baldwin-Lima-Hamilton Company a few years ago is being continued [3].

It was announced that General Motors would build a 2000-hp free-piston engine and matching gas turbine for a locomotive trial. The locomotive will use an electric transmission [4].

[1] Numbers in brackets designate References at end of paper.

Report of Committee RR-6 Survey: Chairman, D. R. Meier; members, R. M. Coultas, H. G. McLean, A. G. Dean.

Contributed by the Railroad Division and presented at the Annual Meeting, New York, N. Y., November 30–December 5, 1958, of The American Society of Mechanical Engineers. Paper No. 58—A-218.

Note: The survey covers the period September 1, 1957, to September 1, 1958.

The report of the Locomotive Development Committee on the coal-fired gas-turbine locomotive indicated that operational results achieved during 1957 were more successful than previous tests. Future plans for the development were not announced [5].

There has been put on test in Czechoslovakia a 3200-hp, 123-ton, gas-turbine locomotive for freight and passenger service, Fig. 3. This locomotive has a mechanical-drive system, with all six axles driven [6].

Renault announced the construction of the first of two 2400-hp free-piston-engine locomotives. This locomotive also has a mechanical drive.

Studies are being undertaken in Germany to determine the feasibility of combining diesel and gas-turbine drives for locomotive propulsion. For light loads, the diesel engine would be used, and for higher loads, the gas-turbine would be used [7].

In Great Britain, the 2500-hp Brown-Boveri gas-turbine electrics continue in passenger service [8].

The Swedish diesel-gas-turbine locomotive, in which the diesel engine is used to produce gas for a turbine which is mechanically connected to the drivers, was reported to have accumulated 120,000 miles since February, 1955 [9].

The USSR is reported to have prepared designs for two gas-turbine type locomotives, one of 6500 hp and one of 7500 hp [10]. The 6500-hp locomotive would use two 7000-rpm gas turbines with electric-drive transmission. The 7500-hp locomotive would use two 3750-hp 8500-rpm turbines. Both locomotives would be 2-unit, 6-axle locomotives.

The Soviets have also been studying locomotive designs for the use of free-piston engines.

It is reported that the Russians have accumulated a total of 1,500,000 miles of operation on a number of producer-gas locomotives [15]. The producer-gas unit is located in the center of a 3-unit locomotive. Anthracite coal is burned to produce the gas. The output of the gas producer is augmented by diesel fuel for starting. The engines are turbosupercharged diesels.

Table 1 Locomotives of Class 1 Railroads of U. S. [1]

	Diesel	Steam	Electric	Gas turbine	Total
Units owned or leased	27590	1737	567	25	29919
Units stored—serviceable	766	819	80	0	1665
Units awaiting repairs	1191	511	69	0	1771

◀ Fig. 1
8500-hp gas-turbine-electric locomotive for Union Pacific

Fig. 2 ▶
Beyer-Garratt locomotive for South Africa

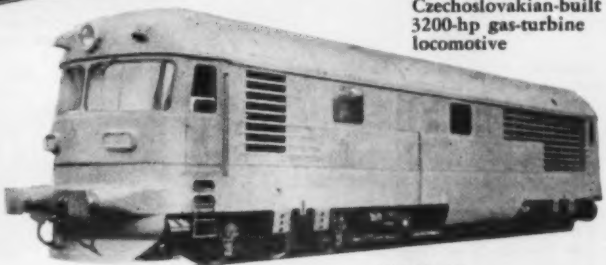


Fig. 3 ▼
Czechoslovakian-built 3200-hp gas-turbine locomotive

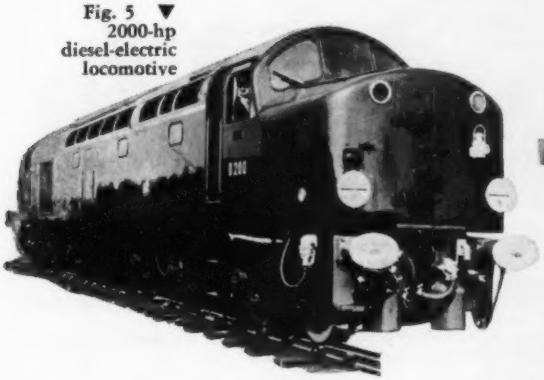


Fig. 5 ▼
2000-hp diesel-electric locomotive

Fig. 4 ▼
Diesel-hydraulic locomotive for British Railways

Fig. 6 ▲
British-built 1160-hp diesel-electric

Fig. 7 ▼
2200-hp diesel-hydraulic British locomotive

A review of developments in railroad motive power and rolling stock, both in the United States and abroad

The Russians are also working on various diesel-engine developments, including an 8-cyl, in-line, 3000-hp, 850-rpm engine having a bore and stroke of approximately 13 in.; a 16-cyl V-type engine with a bore of $9^5/_8$ in. and stroke of $10^3/_4$ in., for 3000-hp at 1000-rpm. Both these enginess are 4-stroke-cycle engines, turbosupercharged to 37 psia. The 16-cyl engine is considered the basic proposal for future developments [15].

The Ansaldo Company of Italy built a 2200-hp hydraulic-drive locomotive which is now in service on the Italian State Railways [16]. This locomotive uses two Maybach engines built under license by Ansaldo, and two Maybach transmissions. Weight of this locomotive is approximately 80 U. S. tons.

In Ireland, a locomotive has been built to burn peat [11].

Maybach has introduced a large hydraulic transmission, designed for 1800-hp input at 1500-rpm. The primary shaft is driven through a step-up gear having a 2:1 ratio. Weight of the transmission including heat exchanger, and including both forward and backward output shafts, is 9000 lb [12].

The German Federal Railway has under consideration a diesel-hydraulic locomotive of 4000 hp. The proposed design would have two 16-cyl engines and would use a C-C truck arrangement [13].

Diesel Locomotives

The British Railways are proceeding with their motive-power modernization plan. Several of the larger type main-line locomotives will be described.

The Class D-600 locomotive is a 2000-hp, 2-engine locomotive with a hydraulic transmission and A1A running gear, Item 1, Table 2, and Fig. 4. The Western

Table 2 Diesel Locomotives

Alsthom—Société Générale de Constructions Electrique et Mécaniques, Alsthom, France
ALCO—ALCO Products, Inc.
BEE—Brush Electrical Engineering Company, Ltd., England
British—British Railways
BTH—British Thomson-Houston Company, Ltd., England
BTL—Brush Traction Ltd., England
C—Crossley Bros., England
Canada—Canadian National Railways
CB—Cooper-Bessemer Corporation
DB—Daimler-Benz, Germany
Ecuador—Ecuador Railways
EE—English Electric Company, England
EMD—Electro-Motive Division of General Motors Corporation
FB—Société Franco-Belge de Matérial de Chemins de Fer, France
GE—General Electric Company
GM—General Motors Diesel, Ltd., Canada
HKKMN—Hitachi, Ltd., Kawasaki Rolling Stock Manufacturing Company, Ltd., Kisha Seizo Kaisha, Ltd. Mitsubishi Heavy-Industries, Reorganized, Ltd., Nippon Sharyo Seizo Kaisha, Ltd., Japan
Indonesia—Indonesian State Railways
Irish—Coras Iompair Eireann
Japan—Japanese National Railways
Jugoslavia—Jugoslavian Railways
KM—Krauss-Maffei Aktiengesellschaft, Germany
Krupp—Fried. Krupp Maschinenfabriken, Germany
Maybach—Maybach-Motorenbau GmbH, Germany
MBD—Mirrlees, Bickerton & Day Ltd., England
MC—Metropolitan-Cammell Carriage & Wagon Company, England
MV—Metropolitan-Vickers Electrical Company, Ltd., England
NBL—North British Locomotive Company, Ltd., Scotland
NSD—Niigata Engineering Company, Ltd., Shinko Engineering Co., Ltd., Daihatsu Engineering Company, Ltd., Japan
Russia—Ministry of Railways
Sulzer—Cie de Construction Mécanique Procédés Sulzer, Switzerland
Turkey—Turkish State Railways
VKB—Voroshilovgrad Locomotive Works, Kolomna Locomotive Works, Briansk Locomotive Works, USSR

[a] Two gear ratios available automatically
[b] Two cabs on three trucks
[c] Horizontal opposed pistons
[d] Positive displacement blower
P—Passenger
F—Freight
Sw—Switching

Item No.	1	2	3	4	5	6	7
Builder—mechanical	NBL	EE	British	NBL	MC	BTL	KM
Builder—electrical	—	EE	BTH	—	MV	BEE	Maybach
Owner	British	British	British	British	Irish	British	Jugoslavia
Service	P, F	P, F	P, F	P, F	P, F		P
Wheel arrangement	A1A-A1A	1C-C1	B-B	B-B	B-B	A1A-A1A	C-C
Engine data:							
Engines per cab	2	1	1	2	1	1	2
Hp rating per engine	1100/1000	2000	1160	1056	550	1250	1100
Number of cylinders	V-12	V-16	6	V-12	8	V-12	V-12
Bore and stroke, in.	7.09 × 8.27	10 × 12	11.02 × 14.17	7.28 × 7.87	7 × 9	$9^3/_4 \times 10^1/_2$	$7^5/_{16} \times 7^7/_8$
Engine speed, rpm	1500/1445	850	750	1400	1000	850	1500
Cycles	4	4	4	4	2	4	4
Supercharging	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Manufacturer	NBL	EL	Sulzer	Maybach	C	MBD	Maybach
Weight on drivers, lb	179,200	242,000	168,000	174,600	129,920	162,000	211,642
Total locomotive weight, lb.	263,200	292,000	168,000	174,600	129,920	208,000	211,642
Fuel capacity, gal	960	1080	755	960	360	600	925
Driving-wheel diam., in	43	45	45	$39^1/_2$	38	43	$37^3/_8$
Type of transmission	Hydraulic	Electric	Electric	Hydraulic	Electric	Electric	Hydraulic
Track gage, in	$56^1/_2$	$56^1/_2$	$56^1/_2$	$56^1/_2$	63	$56^1/_2$	$56^1/_2$
Maximum speed, mph	90	90	75	90	75	75	75
Fig. no.	4	5	6	7	8	9	10

▲ Fig. 8
Irish Railways
63-in-gage
diesel-electric

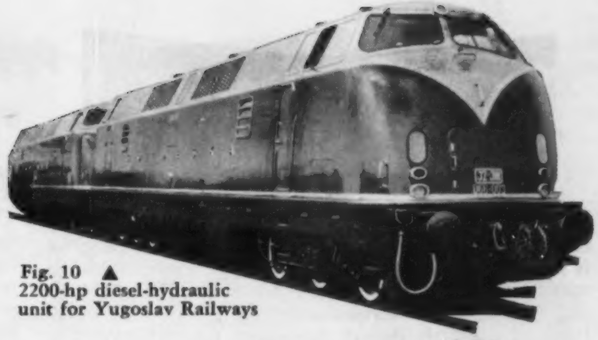


Fig. 10 ▲
2200-hp diesel-hydraulic
unit for Yugoslav Railways

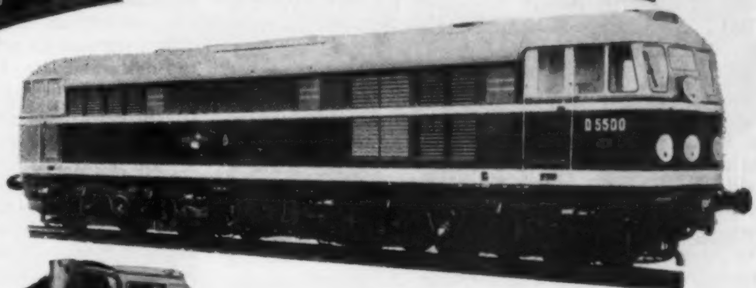
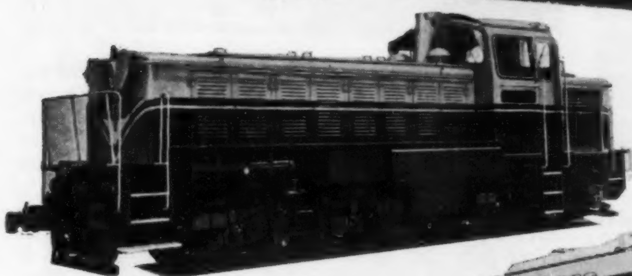


Fig. 9 ▶
One of a
60-unit diesel-
electric order
for Britain



◀ Fig. 11
Krupp-built
diesel-hydraulic
for Indonesia

Fig. 12 ▶
Alsthom-built diesel-
electric for Ecuador

8	9	10	11	12	13	14	15
Krupp	Alsthom/FB	VKB	HKKMN	GE	EMD	ALCO	GM
—	Alsthom	Russian		GE	EMD	GE	GM
Indonesia	Ecuador	Russia	Japan	Turkey	Various	Various	Canada
Sw	P, F	F	Sw	F, P, Sw	F, P, Sw	F, P, Sw	F, P
B-B	B-B-B[b]	C-C	B-B	C-C	C-C	C-C	A1A-A1A (Alt. B-B)
1	1	1	2	1	1	1	1
680	760	2000	370	1980		975	1200
V-12	6	10[c]	6	V-12	V-16	6	V-12
6.89×8.07	9.84×12.60	$8\frac{1}{8} \times 10$	$7\frac{1}{16} \times 7\frac{7}{8}$	$9 \times 10\frac{1}{2}$	$8\frac{1}{2} \times 10$	$9 \times 10\frac{1}{2}$	$8\frac{1}{2} \times 10$
1500	800	850	1300	1000	835	1000	800
4	4	2	4	4	2	4	2
No	Yes	No[d]	Yes	Yes	No	Yes	No
DB	Sulzer	Russian	NSD	CB	EMD	ALCO	GM
79,366	185,190	282,000	125,660	197,000	214,000	151,000	160,000
76,366	185,190	282,000	125,660	197,000	214,000	151,000	240,000
396	951		264	1200	800	600	1200
$35\frac{5}{8}$	$37\frac{3}{8}$	$41\frac{3}{8}$	$33\frac{7}{8}$	36	40	36	40
Hydraulic[e]	Electric	Electric	Hydraulic	Electric	Electric	Electric	Electric
42	42	60	42	$56\frac{1}{2}$	$39\frac{3}{8}$ to 66	36 to 66	$56\frac{1}{2}$
46.6	43.5	62	43.5	60	62	60	65
11	12	13	14	15	16	17	18

Region of the British Railways will, when the program is completed, have 130 diesel-hydraulic locomotives, of which the D-600 is one of four types. The M.A.N. engine and Voith transmission are being built under license by North British Locomotive Company. The Class D-200 locomotive is a 2000-hp diesel-electric locomotive having 1C-C1 running gear, Item 2, Table 2, and Fig. 5. The D-5000 class locomotive is a 1160-hp B-B diesel-electric locomotive, Item 3, Table 2, and Fig. 6. Thirty of these locomotives are now under construction at Derby. Another diesel-hydraulic locomotive for use on the British Railways is the Class D-800, Item 4, Table 2. This is a 2200-hp locomotive having dual Maybach engines and transmissions, Fig. 7. All four of these locomotives use riveted and/or welded trucks. The superstructure of the D-600 is almost entirely aluminum. There is considerable aluminum in the superstructure of the D-5000, as well as a Fiberglas cab roof. The design of Britain's hydraulic-drive locomotives has to a considerable extent been patterned after German designs.

Thirty-four "C" class diesel-electric locomotives are being built for the Irish Railways by Metropolitan Cammell Carriage & Wagon Company. Electrical equipment is being furnished by Metropolitan Vickers. These locomotives are for 63-in. gage, Item 5, Table 2, and Fig. 8.

The Brush Engineering Company is building a total of 60 1250-hp diesel-electric locomotives designated as Class D-5500 for service on the Eastern Region of the British Railways, Item 6, Table 2, and Fig. 9. Some of these locomotives are now in service. The running gear is A1A-A1A cast-steel trucks.

There is great variety in the types of locomotives being used in Britain's modernization plan, as Table 2 indicates. There are different types of running gear, different makes of engines both high-speed and low-speed, and different types of transmissions. This situation has received some comment in the British press [14].

Krauss-Maffei has built a 2200-hp diesel-hydraulic locomotive for service on the Yugoslav Railways, Item 7, Table 2, and Fig. 10. This locomotive has two 1500-rpm Maybach engines, and has all axles driven. It is designed for passenger service. A locomotive very similar to this has been built by Krauss-Maffei, with the horsepower increased to 3000 by adding intercooling to the two 1100-hp engines.

A hydraulic-drive locomotive built by Krupp for the Indonesian State Railways, Item 8, Table 2, and Fig. 11, has a novel arrangement of the transmission. The step-up gear from the engine connects to two torque converters in parallel. Each converter is connected to a 2-stage reduction gear including reversing gear. The output of each of the separate torque converters goes to a particular truck.

Alsthom has supplied five diesel-electric locomotives to the Railways of Ecuador for service to approximately 12,000-ft altitude, Item 9, Table 2, and Fig. 12. The engines are equipped with special turboblowers. The running gear is a B-B-B arrangement and the locomotive has two body sections to accommodate to sharp curves. Rheostatic braking is provided with the engine shutdown.

Russia has in considerable production a 4000-hp, two-unit locomotive designated as the TE-3, partially described under Item 10, Table 2, and shown in Fig. 13. The engine in each unit is a 10-cyl, opposed-piston engine said to closely resemble the Fairbanks-Morse locomotive engine. The motors are permanently connected two in series, three groups in parallel. The trucks are sprung through semielliptic springs fixed to the frame and connected to the journal boxes through equalizers. The centerplate mounting uses rollers working on inclined surfaces to accommodate a motion of 3 in. longitudinally and 1 in. laterally [17].

The Russian locomotive-production schedule for 1958 is said to call for the construction of 375 diesel locomotives and 346 electric locomotives. In 1960, the schedule specifies 1630 diesel locomotives and 550 electric locomotives [18].

The Japanese National Railways are using a diesel-hydraulic locomotive having two engines of 370-hp each for switching service, Item 11, Table 2, and Fig. 14. All of the components for this locomotive are of Japanese manufacture.

The Turkish State Railways have in service five diesel-electric locomotives of 1980-hp built by General Electric Company, Item 12, Table 2, and Fig. 15. These locomotives are similar to the builder's standard line. They are equipped with both dynamic braking and steam boilers.

General Motors announced their Model G-16 locomotive, designed for service on overseas railways, from meter gage through 66-in. gage. This locomotive is equipped with the 16-cyl 567-C engine and has the flexicoil truck design, Item 13, Table 2, and Fig. 16.

Alco announced their Model D-531 road-switcher locomotive for export service for track gages from 37 to 66 in., with low axle loading, Item 14, Table 2, and Fig. 17. Either B-B or C-C wheel arrangement can be used. The engine is the Alco 975-hp, 6-cyl, Model 251.

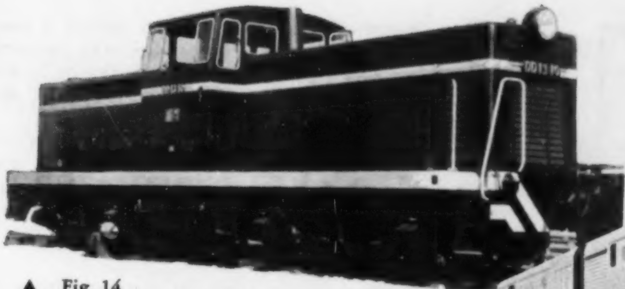
The Model GMD-1 road switcher built by General Motors Diesel of Canada, Item 15, Table 2, and Fig. 18, can be furnished with A1A or alternatively B-B wheel arrangement. It is 1200-hp, designed for freight and passenger duty on branch lines.

General Motors announced the completion of the 1000th unit to be upgraded since the beginning of their remanufacturing program.

Electric Locomotives

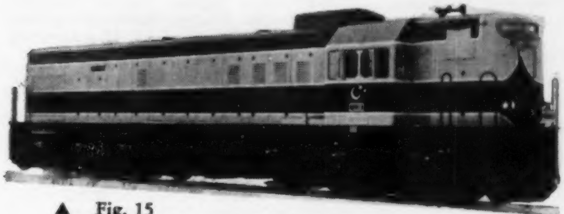
The Swiss Locomotive and Machine Works has built a new type of locomotive for the Rhaetian Railways of Switzerland. The locomotive has a 1-hr rating of 2400 hp and is designed for freight and passenger service, Item 1, Table 3, Fig. 19. The B-B-B running gear under the double-body construction is articulated in the vertical plane only.

Alsthom is building 80 rectifier-type locomotives for the French Railways' use in mixed-traffic service, Item 2, Table 2, and Fig. 20, which feature the use of only one large motor per truck. The two axles are coupled by an intermediate gear, the motor being truck-mounted. A gear-shifting arrangement is provided which makes



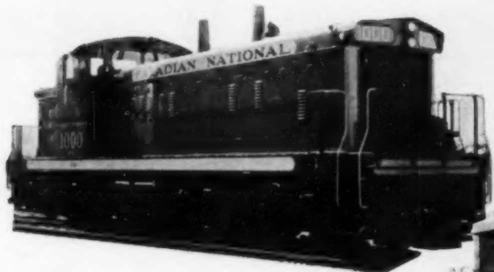
▲ Fig. 14
740-hp diesel-hydraulic for Japanese Railways

Fig. 13 ▼
Russian TE-3, 4000-hp
two-unit locomotive



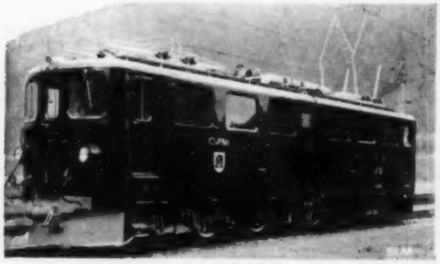
▲ Fig. 15
GE-built 1980-hp unit for Turkey

Fig. 16 ▼
General Motors Model G-66
export locomotive



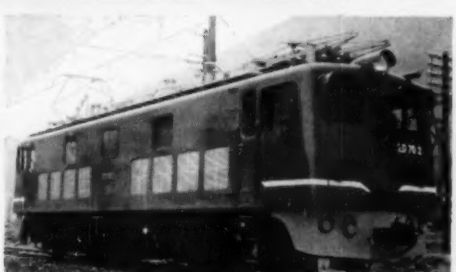
◀ Fig. 17
Alco Model D-531
unit designed for
overseas service

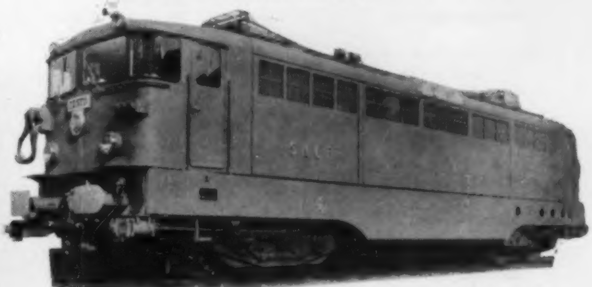
Fig. 18 ▲
Road switcher built by GM Diesel
for Canadian National Railways



◀ Fig. 19
Brown-
Boveri
B-B-B
narrow-
gage
locomotive

Fig. 21 ▶
Japanese
60-cycle
ignitron
locomotive





▲ Fig. 20
Rectifier locomotive for French National Railways

possible a change of gear ratios to occur within 3 min.

After conducting tests for three years, the Japanese have built a rectifier-type locomotive to operate on 20-kv, 60-cycle, single-phase, a-c power, Table 3, Item 3, and Fig. 21.

The Japanese have also constructed a 1500-volt d-c locomotive which has a quill drive arrangement, and also has a specially designed truck in which the center

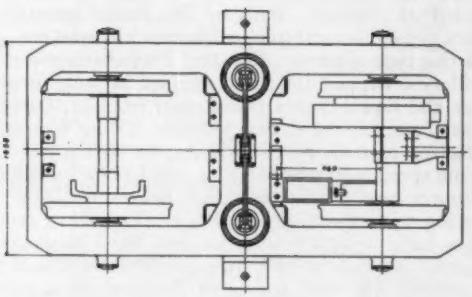
Table 3 Electric Locomotives

ALN—Anglo-Lautaro Nitrate Corporation, Chile
ASEA—Allmänna Svenska Elektriska AB, Sweden
BBC—Brown Boveri, Switzerland
French—French National Railways
GE—General Electric Company
HMKKK—Hitachi, Ltd., Mitsubishi Heavy-Industries, Reorganized, Ltd., Kawasaki Rolling Stock Manufacturing Company, Ltd., Kawasaki Dock Yard Company, Ltd., Kisha Seizo Kaisha, Ltd., Japan
Japan—Japanese National Railways
MEM—Mitsubishi Electric Manufacturing Company, Ltd.
MHI—Mitsubishi Heavy-Industries, Reorganized, Ltd.
NMA—Nydqvist & Holm AB, AB Motala Verkstad, AB Svenska Järnvägsverkstäderna, Sweden
SFAC—Société des Forges et Ateliers du Creusot, France
SFME—Société des Forges et Ateliers de Constructions Electriques de Jeumont & Société "Le Matériel Electrique Sw," France
SLM—Swiss Locomotive & Machine Works, Switzerland
Swedish—Swedish State Railways
Swiss—Rhaetian Railways
TMT—Tokyo Shibaura Electric Company, Ltd., Mitsubishi Electric Manufacturing Company, Ltd., Tokyo Electric Manufacturing Company, Ltd., Japan

[a] Vertical articulation over center truck
[b] Equipped with two selective gear ratios
[c] Two cabs

P—Passenger
F—Freight
Sw—Switching

Item No.	1	2	3	4	5	6	7
Builder—mechanical	SLM	Alsthom	MHI	HMKKK	GE	NMA	SFAC
Builder—electrical	BBC	Alsthom	MEM	TMT	GE	ASEA	SFME
Owner	Swiss	French	Japan	Japan	ALN	Swedish	French
Service	P, F	P, F	P, F	P, F	F, Sw	F	P, F
Wheel arrangement	B-B-B[a]	B-B	B-B	B-B	C-C	2-8-8-2[c]	B-B
Power supply	11 kv, $16^2/_3$ cps	25 kv, 50 cps	20 kv, 60 cps	1500 volt d-c	600 volt d-c	15 kv, $16^2/_3$ cps	25 kv, 50 cp
Power conversion	Series motors, a-c	Ignitron rec.	Ignitron rec.	Series motors, d-c	Series motors, d-c	Series motor, a-c	Ignitron rec.
Current collector	Pantograph	Pantograph	Pantograph	Pantograph	Pantograph	Pantograph	Pantograph
Driving wheels:							
Number	12	8	8	8	12	16	8
Diameter, in.	$42^1/_8$	$54^5/_{16}$	$44^1/_8$	$44^7/_8$	36	$60^1/_4$	$49^1/_4$
Weight, lb.:							
Total	143,500	149,900	136,500	125,660	180,000	396,900	185,190
On drivers	143,500	149,900	136,500	125,660	180,000	335,160	185,190
Per driving axle	23,900	37,480	34,125	31,415	30,000	41,900	46,297
Dimensions, ft-in.:							
Length over-all	$47\text{-}6^7/_8$	47-3	$46\text{-}9^1/_2$	42-8	49-8	$82\text{-}4^1/_4$	$53\text{-}1^3/_4$
Width over-all	$8\text{-}8^9/_{16}$	$9\text{-}9^1/_2$	$9\text{-}2^1/_4$	$9\text{-}2^1/_4$	9-0	$11\text{-}0^7/_8$	$9\text{-}9^1/_4$
Height, panto. down	$13\text{-}1^1/_2$	11-11	$13\text{-}7^3/_8$	$12\text{-}11^7/_8$	13-9	$14\text{-}9^1/_8$	—
Rigid wheel base	$8\text{-}2^7/_{16}$	$5\text{-}3^5/_{16}$	$7\text{-}10^1/_2$	$8\text{-}2^7/_{16}$	11-6	—	10-6
Total wheel base	36-5	$33\text{-}2^1/_2$	$32\text{-}1^7/_8$	$28\text{-}6^1/_2$	36-8	$70\text{-}1^3/_8$	$40\text{-}8^1/_4$
Traction motors:							
Number	6	2	4	4	6	4	—
Method of mounting	Truck	Truck	Truck	Truck	Axle hung	Platform	Axle hung
Method of drive	Resilient	Resilient	Quill	Quill	Gear	Conn. rods	Resilient
Gear ratio	1:5.44	(1:1.88) (1:3.22)[b]	1:5.69	1:5.47	1:5.53	1:4.24	—
Tractive force, lb:							
One-hour rating	30,100	(P) 26,450 (F) 45,190	35,300	28,660	—	55,120	—
Per cent adhesion	21.0	(P) 17.6 (F) 30.2	25.8	23.2	—	16.4	—
Continuous rating	23,600	(P) 25,350 (F) 42,990	32,400	25,132	33,400	—	—
Per cent adhesion	16.4	(P) 16.9 (F) 28.7	23.7	20.0	18.6	—	—
Rail horsepower:							
One-hour rating	2310	3550	2090	2080	—	5000	5200
Continuous rating	1990	3450	1950	1920	1800	—	4850
Maximum	—	—	—	—	—	—	—
Speed, mph:							
One-hour rating	28.8	(P) 50.3 (F) 29.5	22.2	27.3	—	34.3	—
Continuous rating	31.6	(P) 51.0 (F) 30.1	22.6	28.6	21	—	—
Maximum	47.0	(P) 93.2 (F) 55.9	55.9	55.9	50	46.6	99.4
Regeneration	Yes	No	No	No	No	No	No
Multiple-unit operation	No	Yes	Yes	No	No	Yes	No
Track gage, in.	$39^3/_8$	$56^1/_2$	42	42	42	$56^1/_2$	$56^1/_2$
Fig. no.	**19**	**20**	**21**	**22, 23**	**24**	**25**	**26**



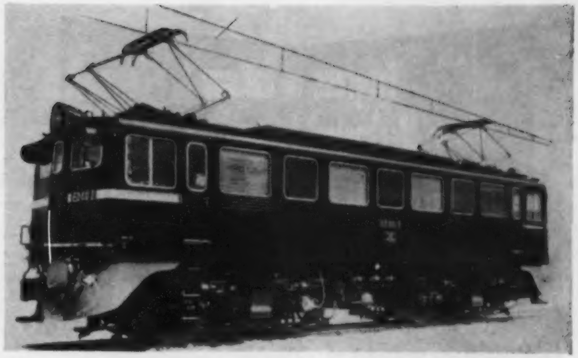
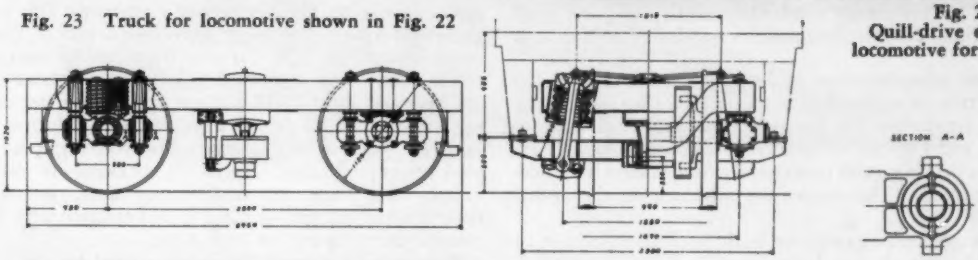
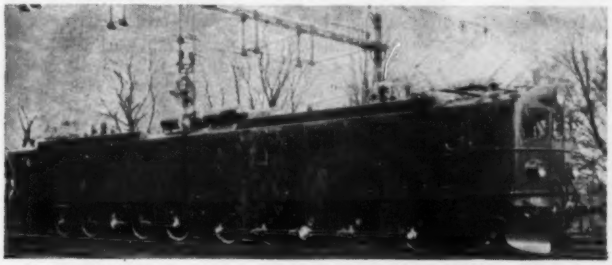


Fig. 23 Truck for locomotive shown in Fig. 22

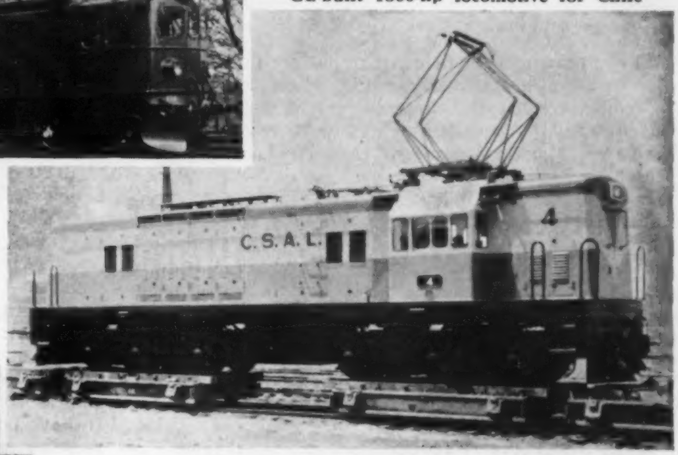
Fig. 22 ▲
Quill-drive electric locomotive for Japan

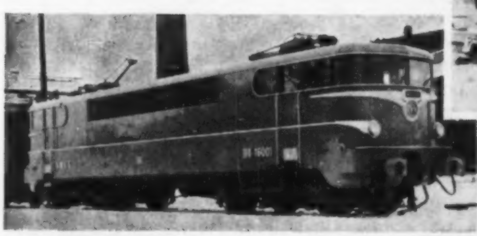




▲ Fig. 25
Swedish-built ore-haulage locomotive

Fig. 24 ▼
GE-built 1800-hp locomotive for Chile





▲ Fig. 26
French-built ignitron rectifier locomotive for use on 25-kv line

◀ Fig. 27
Hudson-Manhattan rapid-transit car

pivot is only 13 in. above the rail, Item 4, Table 3, and Figs. 22 and 23. This minimizes truck tilting and improves adhesion.

The General Electric Company built for Anglo-Lautaro Nitrate (Chile), two 600-volt d-c electric locomotives, Item 5, Table 3, and Fig. 24. These locomotives were designed for maximum interchangeability of parts with 900-hp diesel-electric locomotives purchased at the same time.

Various manufacturers in Sweden contributed to the construction of eight electric locomotives for use in ore-haulage service on the Swedish State Railways, Item 6, Table 3, and Fig. 25. These are 2-unit locomotives having eight driving axles powered by four motors and side-rod connected. The motors are mounted on the underframe.

A new electric locomotive built in France for use on 25-kv, 50-cycle electric lines, Item 7, Table 3, and Fig. 26, accomplishes power conversion by ignitron rectifiers. The motors are axle-hung and the drive is through flexible gears.

Passenger and Freight Cars

In the passenger-car field, there has been considerable activity in rapid-transit equipment where developments to reduce weight and improve performance have received study. A number of noteworthy installations, both abroad and in America, have taken place during the year.

In the freight-equipment field, the year has seen continued development and application of trailer-carrying flatcars and a variety of container arrangements for coordinated rail-highway service. The trend toward increased types and quantities of special-purpose cars—now in excess of 70,000 in the U.S.—has shown marked progress. Examples of such cars range from "canopy" cars built to haul aircraft wing sections and gondola cars designed to hold rubber containers for bulk-materials handling, to round-topped cars that open like clams for haulage of steel coils.

Rapid-Transit Cars. Fifty cars built by the St. Louis Car Company for the Hudson and Manhattan Railroad, Fig. 27, present some departure from regular rapid-transit equipment in that they were built to meet the newly established Interstate Commerce Commission strength requirement of 400,000 lb buff, as well as the other strength specifications. Ten tons of air conditioning are provided with 3000-cmf total air distribution, including 40 per cent of fresh air. The over-all length is 51 ft 3 in., and the weight 69,300 lb. Ten of the cars have two cabs and 40 have single cabs and are arranged for operation as 20 semipermanently coupled pairs. Each car is powered with four GE 100-hp transit motors giving acceleration of $2^1/_2$ mph per sec with a maximum speed of 60 mph. The cars accommodate 40 to 46 seated passengers in longitudinal seats and will accommodate a maximum of 152 passengers.

Lightweight Electric M-U Cars. The Pennsylvania Railroad has placed in service six stainless-steel Pioneer suburban coaches. Built by The Budd Company, these cars possess several unique features hitherto not applied to this type of service, Fig. 28. Propulsion power is 650-volts d-c stepped down and rectified by an ignitron rectifier and liquid-cooled transformer from 11,000-volt, 25-cycle, a-c, and fed to two 300-volt, 100-hp Westinghouse traction motors, wired in series, on each truck. Maximum speed is 90 mph. Three cars have all-welded Budd Pioneer type trucks and disk brakes utilizing an air spring to support the car body. The three remaining cars have a lightweight General Steel Castings truck supporting the car body by a combination of coil and air springs. The coil spring is designed to support the empty car with the air spring supporting the varying passenger load by means of a leveling device. These are inside-journal equalizer trucks with central bearing between the bolster and the truck frame. Bolster springs are between the bolster and car body. Bolster anchors prevent the bolster from swiveling with relation to the car body. These cars are braked by Westinghouse Cobra package-type brakes. Dynamic braking is not provided. An 8-ton air-conditioning unit, mounted at floor level at one end of the car, and electric strip heaters control the temperature in the car.

Reinforced polyester Fiberglas is used for the interior lining of the car. Three-and-two seating arrangement has resulted in a passenger capacity of 125.

The cars are 85 ft long and weigh approximately 89,400 lb with the welded truck and 93,200 lb with the cast truck. Full AAR and ICC strength and safety provisions are incorporated.

Japanese Railways. In Japan, a number of interesting developments have taken place during the year. Fig. 29 illustrates one of three 8-car multiple-unit electric trains. Each train, designed to operate on the newly completed 1500-volt, d-c, electrified line between the major industrial cities of Tokyo and Osaka, consists of a driving trailer, two motored cars, two trailers, two motored cars, and a driving trailer in the order given. The train weighs 516,000 lb and seats 424 people. The trains are designed for a maximum speed of 99 mph on Japan's standard 42-in-gage track.

A Japanese experimental train, consisting of a power car and a trailer, designed for use under either d-c or a-c trolley, is shown in Fig. 30. The d-c power is supplied directly from the pantograph to the 1500-volt d-c traction motors. Under single-phase, 50-cycle, 20,000-volt trolley, power is converted through transformers and mercury rectifiers. The railway intends to make tests using dry-type silicon rectifiers in the near future.

Indian Railways. During the year, 64 3-unit M-U electric trains were delivered to the Indian Railways for new service between Calcutta and Birdwan. The trains were supplied by German, British, and Swiss builders. One of these trains, the mechanical portion having been built by Maschinenfabric Augsburg-Nürnberg and the electrical equipment furnished by Allgemeine Elektricitäts Gesellschaft, is shown in Fig. 31. The trains are the first to operate in India at 3000-volts d-c. They operate on 66-in-gage track and have a maximum speed of 62 mph.

Bilevel Passenger Cars. The C&NW has taken delivery of 13 bilevel passenger cars for mainline service. They are designed to offer high capacity, low weight per seat. There are 10 96-passenger coaches, 1 full-length 60-passenger parlor car, 1 coach-bar-lounge car for 80

Fig. 28 ▶
Budd-built
Pioneer
suburban cars

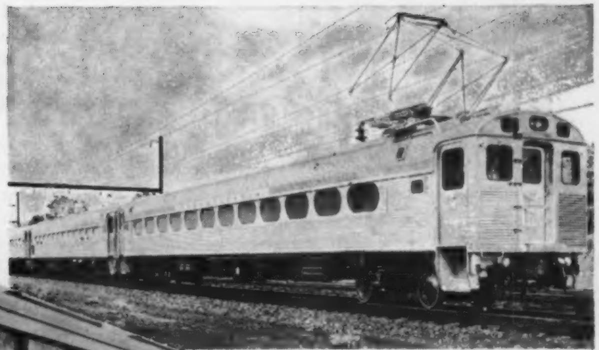
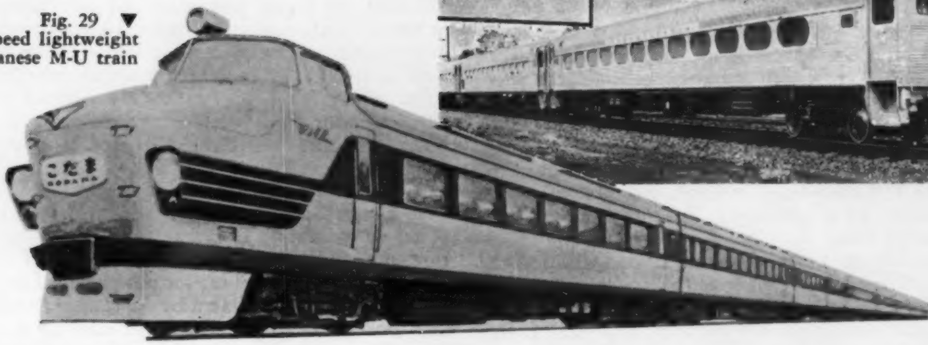
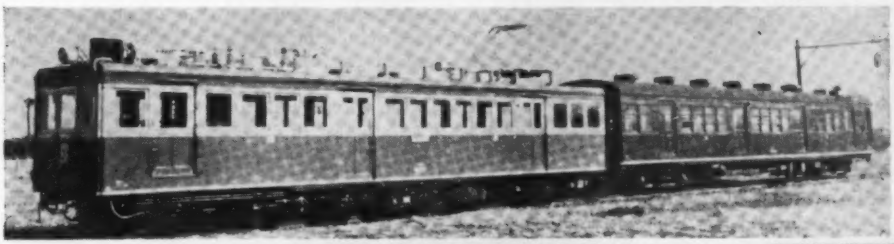


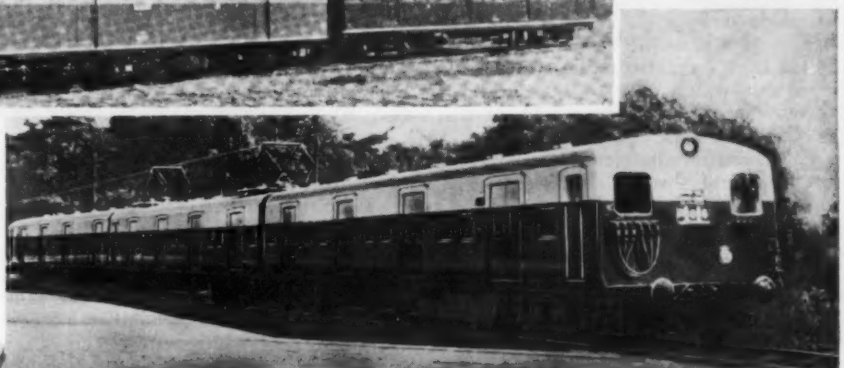
Fig. 29 ▼
High-speed lightweight
Japanese M-U train





◀ Fig. 30
Experimental a-c
and d-c dual
purpose cars

Fig. 31 ▶
66-in-gage
electric train
for India



◀ Fig. 32
Bi-level
coach-parlor
car for C&NW

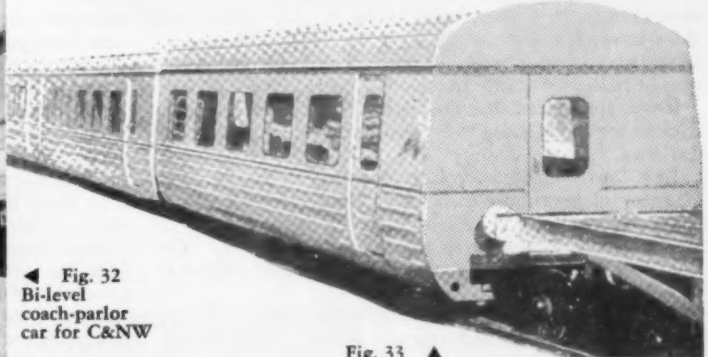


Fig. 33 ▲
Lightweight cars for
Swedish State Railways

passengers, and one coach parlor car for 78 passengers. The cars are of 85-ft length of lightweight-girder design, welded-and-riveted construction, of high-strength, low-alloy steel conforming to AAR strength requirements. The 15-ft 10-in-high cars are a definite departure from conventional equipment. Power supply is generated in the locomotive and train-lined through the cars to be used for car heating, air conditioning, lighting, water coolers, and similar purposes.

The interiors are designed to cut railroad cleaning and maintenance costs through the use of modern vinyl plastics, anodized aluminum, and stainless steel, thereby virtually eliminating painted surfaces, Fig. 32. Lighting is fluorescent and windows are graduated tinted glass. This equipment will be used in long-distance rather than commuter service.

Lightweight Trains. A 7-car lightweight, 4-axle-per-car train has been built for the Swedish State Railways. Each $37^1/_2$-ft-long coach has between 24 and 40 seats, depending upon varied interior arrangement. The short length of the cars has facilitated the use of a tubular design with a very low center of gravity. The train is pulled by a diesel-hydraulic 1020-hp locomotive. The seven cars weigh only 140,000 lb and the locomotive, powered by two Cummins VT-12 engines, weighs 80,000 lb. Three of these cars are shown in Fig. 33.

The trains for the New Haven Railroad described in last year's report were placed in service on the New York to Boston and New York to Springfield runs. Each of these trains has demonstrated its ability to operate between New York and Boston on a $3^1/_2$-hr schedule. This schedule was not adopted due to lack of stand-by equipment capable of maintaining schedule. Dining facilities were added to each of these trains by the Railroad.

Revised schedules necessitated the use of trains of larger capacity than the lightweights. The Budd "Roger Williams" train was divided to furnish equipment for other services. Pullman's "Daniel Webster" and the American Car & Foundry's "John Quincy Adams" were withdrawn from service. New developments along these lines are apparently being held in abeyance pending more complete evaluation of the existing equipment and also of passenger-traffic trends.

It was announced that the General Motors Aerotrain is back in service in suburban operation on the Rock Island Railroad.

Tank Cars. American Car & Foundry has built a quantity of maximum-load tank cars for high-pressure commodities, Fig. 35. Each tank provides a capacity of 19,000 gal as compared to the more usual 10,000. On this basis the cost of the tank car per thousand gallons is considerably improved.

The Union Tank Car Company, in its model HD car, has eliminated the underframe and dome with a possible elimination of side running boards.

General American Transportation Corporation has fabricated car tanks "Kanigen" lined—a plating process depositing nickel alloy inside the tanks. This provides a surface which is harder than normal electroplating and uniform in thickness even in complicated shapes. The cars are used for the transportation of various corrosive commodities, Fig. 34.

Tests conducted on tank cars have demonstrated that light-colored paint on the tank exterior permits using the tank for liquid petroleum and anhydrous ammonia without insulation. Pressure variations with temperature remain within acceptable levels. These tests have caused revision of ICC specifications which have previously required 4 in. of insulating material.

Refrigerator Cars. One of 1000 refrigerator cars being built by Pacific Fruit Express Company for its own service is shown in Fig. 36. These cars are electromechanically refrigerated using diesel-driven brushless alternators. Five hundred are to be 50-ft, 50-ton cars, and 500 to be 40-ft, 40-ton cars. Doors are 6 ft. by 8 ft. Temperatures may be controlled between -10 and $+70$ F within 2 deg, and 500-gal fuel capacity is provided in each car.

Cargo space is ventilated by ducting in the floor, sides, and roof where 80 per cent of the cool air is circulated, with 20 per cent for actual ventilation. An indicator light to show that the refrigeration equipment is operating is provided which may be seen from the ground or from the roof of the cars. High-speed, roller-bearing freight trucks are provided. Considerable care is given to the insulation to minimize loss and to prevent quick temperature rise in case of engine shutdown. Temperatures can be held low enough to permit transportation of frozen foods.

Hopper Cars. An all-welded, extra-large-capacity (3219 cu ft) covered hopper car, designed and built by Pullman-Standard, which provides increased capacity and new economies in the shipment of bulk commodities, Fig. 38, could well have favorable influence on future grain shipments. Although the car is higher and wider than its predecessors (2003 and 2893-cu-ft capacities), the length has been kept to 46 ft over the end sills, and location of loading hatches and unloading gates are unchanged so that the car can be used with existing facilities. The car has the same construction features as the two smaller Pullman-Standard standardized models.

A 100-ton (119-cu-yd), air-operated hopper car built by Baldwin-Lima-Hamilton Company, Fig. 37, has air-operated doors. The light weight of this car is 64,900 lb.

"Compartmentizer." The Pullman-Standard Compartmentizer is an adjustable-bulkhead device, permanently installed in a boxcar, Fig. 39. It is designed to permit more efficient stowing of lading and to reduce or eliminate damage to lading. The Compartmentizer consists of a set of gates in each end of the car, Fig. 40. Beginning at the bolster, these gates are adjustable at $3^1/_4$-in. increments to the doorway of the car, thus permitting maximum flexibility in load planning. In addition, the gates may be locked in the extreme ends of the car flush against the end lining. They occupy only $4^1/_4$ in. of longitudinal floor space in each end, thus permitting general-purpose car use if desired. Completely installed in a boxcar, the Compartmentizer weighs about 6000 lb. However, it does not interfere with the load potential of the car since a load limit of about 119,000 lb remains with a standard boxcar. The load limit with insulated boxcars is proportionately lower depending on the size of the car, but payloads are not restricted. One man can secure or unlock the gates with minimum effort.

Cushion Underframe. Pullman-Standard has built cars

◀ **Fig. 34**
GATX Kanigen-lined tank car

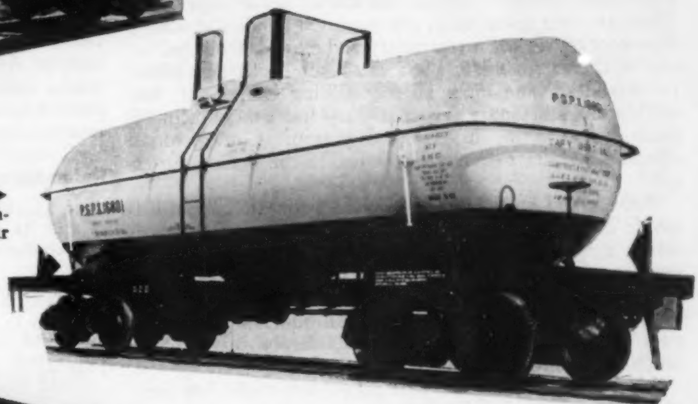


Fig. 35 ▶
ACF high-pressure tank car

◀ **Fig. 36**
PFE electromechanical refrigerator car

Fig. 37 ▶
B-L-H air-operated hopper car

◀ **Fig. 38**
P-S all-welded, bulk-commodity hopper car

incorporating its new cushion underframe. The design is intended to reduce impact forces on a freight-car structure and its lading. It employs a new design of boxcar underframe and new cushion pad and pocket arrangement. There are two center sills, one mounted inside the other; the outer center sill is stationary and extends from end to end of the car. Bolsters and cross members are attached to this sill. The inner sill, or sliding center sill, fits within the stationary center sill and has a movement of more than 10 in. in either direction. Conventional couplers and draft gears are attached to the sliding center sill.

Rubber and steel bonded cushion pads are assembled inside of the sliding center sill at the center of the car, with a preload of approximately 30,000 lb. The cushioned forces are transmitted from the cushion assembly into the stationary center sill through heavy steel keys located at each end of the cushion assembly. Impact forces are reduced to approximately one half as much as when coupling standard cars.

Piggyback. During the year piggyback traffic has continued to increase and developments have been concentrated in standardization of equipment and methods. Large-scale broadening of interchange agreements, mechanical and car-service rules, and so forth, have contributed to standardizations of types of equipment covered in previous reports. Techniques applicable to individual railroads have, however, continued. For example, the New York Central's "Flexi-Van" service has been expanded to a large number of key cities on its system. This version of piggyback was described in last year's report. The Southern Car & Manufacturing Company has introduced container equipment which, by means of transfer arms applicable to either truck trailers or flatcars, is designed to provide flexibility of general-purpose containers in co-ordinated haulage services.

A system for handling highway trailers which is usable with existing piggyback ramps, trailers, and flatcars has been developed by Pullman-Standard and Trailmobile, Inc. Existing flatcars could be equipped for this system by adding supporting piers atop each corner of the car.

Acknowledgments

The Committee on Survey wishes to acknowledge with deep appreciation the assistance in procuring material for the report given by *Railway Age*, *The Railway Gazette*, *Railway Locomotives and Cars*, *Oil Engine and Gas Turbine*, *Diesel Railway Traction*, *The Locomotive*, and the Association of American Railroads' *Reports*, and by the railroads, locomotive and car builders, and equipment suppliers who so generously furnished much of the information used in compiling the report.

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▼ Fig. 39
P-S compartmentizer car

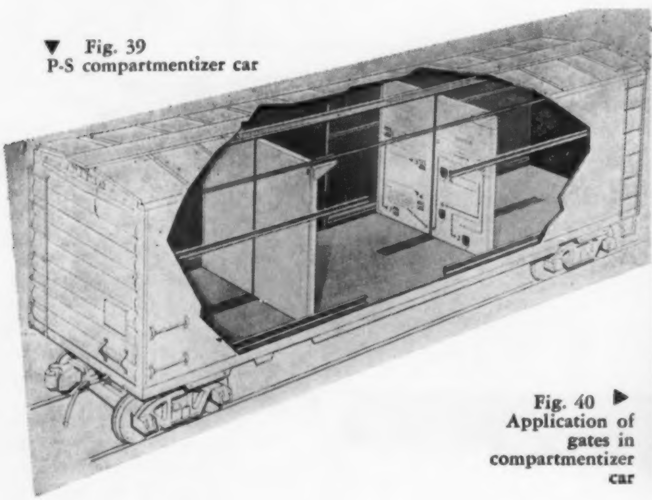

Fig. 40 ▶
Application of gates in compartmentizer car

Abstracts and Comments Based on Current Periodicals and Events

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Assistant Editor

BRIEFING THE RECORD

Progress in Metals Engineering

"Melting metals in jets of heat ranging up to 30,000 F, steels with strengths exceeding 400,000 psi, perfection of techniques for the forming of metal parts by controlled explosions, and the rolling of metal strip directly from metal powders, are among the outstanding metals-engineering developments of 1958," according to a year-end report on metallurgical advances by Clarence H. Lorig, president of the American Society for Metals, and technical director of Battelle Memorial Institute, Columbus, Ohio.

In addition to the 4000 or 5000 F requirements for aircraft and missile use, metals are needed at the other end of the temperature scale. Oxygen, nitrogen, hydrogen, and flourines, which are being used in liquid form as energy sources, must be held in the range of −346 to −434 F. Only a few metals retain ductility at these temperatures and then only under certain conditions. Some stainless steels and certain copper, aluminum, and titanium alloys can be used for storing liquefied gases, but there are many fabrication problems. Highly corrosive conditions often accompany low temperatures, adding to the complications.

A device known as the plasma-jet, which started life within the past two years as a research tool for generating extremely high temperatures, is now being adapted to production uses (Mechanical Engineering, January, 1959, pp. 46–47). Temperatures up to 30,000 F are being used to melt and apply metals and compounds with extremely high melting points, to build shapes on mandrels, or to coat surfaces of other materials.

Stronger materials that are relatively easy to form and fabricate into engineering structures are the goal of metallurgists. Two such steels were introduced during 1958. One is an air-cooling ultrahigh-strength alloy steel available in sheet form which develops tensile strengths up to 280,000 psi upon air cooling (Mechanical Engineering, October, 1958, p. 84). The steel is reputed to have good formability and to be readily welded. It is formed in the annealed condition, then heated and permitted to cool in air at room temperatures. Then follows a tempering treatment at a lower temperature and another air-cooling cycle.

The second steel is only a few steps removed from the research laboratory (Mechanical Engineering, December, 1958, p. 77). In tests the new steel has shown tensile strengths of more than 400,000 psi—a level never before reached with any metal. If the same strength levels can be matched in production quantities, the new steel will compete favorably with titanium alloys on a strength-to-weight basis. The steel is reported to have high ductility as compared to similar compositions of steel which are notoriously brittle, and retains ductility to −385 F.

A recognized, but little understood, phenomenon in metals is that, under proper conditions of time and pressures, metals can be made to behave in a manner similar to that of viscous liquids. This odd behavior is being used to produce large, complicated shapes in metals difficult to form by the usual methods.

Popularly known as "explosive forming," the process actually is "high-energy-rate" metal forming. There are many variations of the process, but in essence all involve extremely high forces which can be applied in a fraction of a second.

Usually an explosive charge such as dynamite or TNT is used, but one machine is capable of developing extremely high pressures and releasing them with virtually no time delay. When explosives are used, energy can be transmitted through air, water, or some other medium. Some simple shapes can be formed without dies. Others require only a female die made of plastics, tool steel, or even plaster or cement.

Many parts are now made in this manner. Explosive force is also being considered for such diverse tasks as surface hardening of steel, riveting, hole piercing, embossing, compacting of metal powders, forging, bonding, and casting under pressure.

Powder metallurgy will probably be extended in use by a new low-alloy iron powder which does away with the limitation of relatively low strengths in structural uses. The new powder provides a tensile strength of 110,000 psi after heat treatment. This can be increased to 180,000 to 190,000 psi in the heat-treated condition by annealing, repressing, and sintering.

Metal strip is also being produced directly from metal powders, and has been successfully rolled in thicknesses of 0.050 to 0.060 in. and in widths up to 11 in. at a rate of 6 fpm. Properties of copper strip made in this manner are said to equal those of conventional electrolytic copper strip.

Many nonferrous metals continue to be studied intensively by metallurgists and metals engineers (Mechanical Engineering, August, 1958, pp. 57–62, 67–71). Included in the studies are titanium, zirconium, beryllium, columbium, tungsten, molybdenum, and vanadium.

Considerable progress has been made in securing pure metals through the use of electron-beam vacuum melting. In using the process, ingot, flake, sponge, powder, or sintered metal is fed into a vacuum chamber where it is

melted by the beam from the electron gun, while a similar beam keeps a molten pool of metal at the surface of an ingot which is slowly withdrawn from the heating area as the bottom solidifies.

Columbium is now being produced commercially by the electron-beam method with extremely high purity. Oxygen, for example, is reduced to about 100 ppm. Application is expected to tantalum, molybdenum, beryllium, and special steels and stainless alloys.

Steelmaking is one of our oldest arts, but both products and production methods are being improved and the output of existing blast furnaces is being increased. Much of this increase in production is credited to the use of ore beneficiation, burden sizing, and oxygen-enriched air in the blast furnace (MECHANICAL ENGINEERING, February, 1958, p. 86).

Ordinary steels are being used in applications where once they were excluded or at best served for only short periods. Added life through resistance to heat and corrosion is provided by coatings such as ceramics and aluminum, and aluminum-coated steels are used extensively for mufflers and other parts of 1959 automobiles.

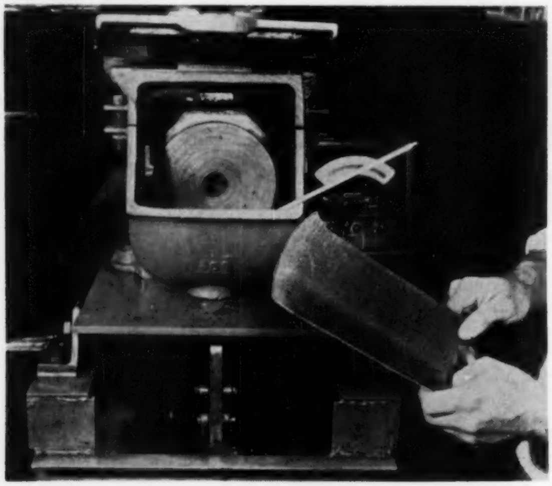
Unlubricated Bearings

A NEW, low-friction bearing composed of strong fabric impregnated with Bakelite phenolic resin promises to eliminate the need for lubricating bearings in mechanical applications ranging from miniature instruments to hydroelectric stations. In some instances, such bearings have outlasted the life of conventional metal bearings by as much as eight times.

Called Ruslon bearings, they are made by the Russel Manufacturing Company of Middletown, Conn., and can replace many conventional metal-to-metal bearings which must be lubricated with oil.

In a typical automotive application, a bearing in a steering knuckle withstood a 200,000-mile simulated-travel test with no signs of wear or oxidation. Automobile ball joints lined with this material, tested by a leading manufacturer for the expected life of the car,

Fiber bearings impregnated with Bakelite phenolic operated at 350 F for two weeks in this journal box



were found to be in perfect condition at the conclusion of the tests.

The new bearings employ both plastic and cotton yarns woven into fabric and then immersed in a solution of phenolic resin. The latter is a high-strength and heat-resistant form of plastic designated BLS-2680 by the supplier, Union Carbide Plastics Company, Division of Union Carbide Corporation.

After low-temperature, 180 F, air drying, the fabric is cut into shapes determined by the particular bearing application. It is then bonded to the metal receptacle containing the bearings with heat-sensitive adhesive and both fabric and holder are placed in a press for joining.

Russell uses pressures of approximately 7 to 10 tons per sq in. and a temperature of 340 F to accomplish two jobs at once—setting up the phenolic resin, and flowing the adhesive for a perfect bond between the metal-bearing housing and the resin-impregnated fabric.

The combination of Bakelite phenolic and fabric used in the new bearings also supplies strength in a permanently infusible form. In addition, the phenolic is lightweight, resistant to heat up to 350 F, dimensionally stable under most atmospheric conditions, and has a low coefficient of friction.

The bearings are resistant to acids and alkalies and are not subject to electrolysis or corrosion by salt water.

The major use of the new bearings, the manufacturer predicts, will be in the automotive field where knuckle and ball joints will function for the life of the car without lubrication and without wear. Other fields of application include general machinery, and especially materials-handling equipment, marine equipment employing thrust bearings, elevator slides, and aircraft uniball joints and trimtab bearings.

New Helium Facilities

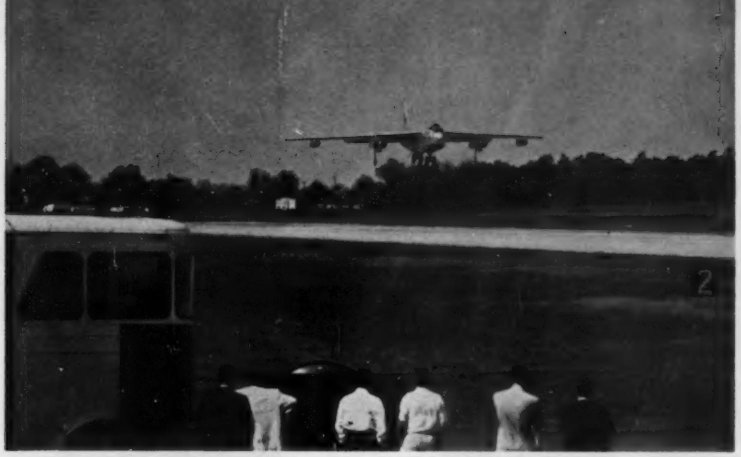
A $1,959,000 contract for 20 special railway tank cars to transport helium gas produced by the Bureau of Mines has been awarded to the American Car and Foundry Division of ACF Industries of New York, N. Y.

Delivery of the cars is to coincide with completion of a new helium-production plant at Keyes, Okla., next August. When all tank cars now on order are received, the Bureau of Mines will have 163 in service, of which 25 will belong to the Atomic Energy Commission. All cars are used for shipping helium as they become available, regardless of ownership, so that the tank-car pool can operate as efficiently as possible.

Each of the new cars will consist of 30 seamless steel cylinders mounted with valves, manifolds, and safety devices in a steel framework on standard railway trucks. Each will weigh about 100 tons empty and—since helium is so light—only about 101 tons when fully loaded with more than 200,000 cu ft of compressed gas.

The Bureau of Mines is the only volume producer of helium in the free world. With four plants—at Amarillo and Exell, Tex., Otis, Kan., and Shiprock, N. Mex.—it expects to produce and ship nearly 360 million cu ft of the essential gas this year. Completion of the new $12-million plant at Keyes, Okla., will increase production capacity by approximately 290 million cu ft.

This additional capacity is urgently needed in atomic-energy, missile-development and space-exploration programs, and for expanding uses in industry. Demand has mounted so rapidly that the gas is now in short supply.



A B-47 jet comes in electronically. Automatic radar tracking informs devices in the trailer which take complete control during approach and landing.

All-Weather Landing System

An automatic electronics all-weather landing system developed by the Bell Aircraft Corporation has safely landed a B-47 bomber in a test at Lockheed Aircraft Corporation near Atlanta, Ga. The system may end aircraft stack-ups which cause airport traffic congestion and permit flights normally canceled because of low minimum weather. The electronic devices take over during approach and landing, and improve the landing of aircraft under Instrument Flight Rule conditions. Lockheed's Georgia Division is evaluating the system for eventual incorporation in the B-47.

Bell Aircraft engineers claim that holding time at airports is cut to a minimum because the system enables landing of 120 aircraft an hour, a record hard to beat in any weather, fair or foul. Flexible enough to handle any airplane from a single-seater Piper Cub to Lockheed's huge propjet C-130 cargo carrier, the system underwent two weeks' exhaustive testing on Dobbins Air Force Base runways.

Basically the system employs an automatic radar-tracking beam which tracks the approaching aircraft and supplies accurate position information to the electronic computer. With this closed-loop system, the actual flight path of the aircraft being landed is measured and compared with the desired flight path, and any difference between the measured and the desired flight paths results in correction signals which are sent by radio to the plane's autopilot.

The autopilot controls the aircraft as long as the pilot desires—until visual reference is established or to actual touchdown. The mere press of a switch on the autopilot instantaneously restores control of the aircraft to the pilot.

The landing system used in the tests was housed in a trailer parked adjacent to the runway being used for landing. Power for its operation was obtained from a mobile power unit driven by a diesel or gasoline engine.

The data length used in the test is compatible with the Instrument Landing System receiver equipment already installed in many present-day aircraft. In the computer are stored data on a number of airplane types for instant use.

With the mere push of one or two buttons, any type of aircraft can be landed automatically. A control monitor sitting at a console in the trailer follows the entire automatic operation. To aid him, a radarscope is provided in addition to a plotting board on which is shown the actual glide path as compared to the desired glide path.

A recorder is available to record desired information pertaining to aircraft position, position error, speed, and acceleration. In addition, the actual command transmitted to landing aircraft also can be recorded. Thus a permanent record of each landing is obtained.

In case of airborne equipment malfunction, these facilities and voice communications supply data equivalent to those provided by present approach systems. Automatic wave-off goes into action whenever equipment malfunctions or there are excessively large errors.

The information transmitted to the airplane is displayed on conventional cockpit instruments in the plane and will allow manual landing by the pilot instead of the autopilot.

The Bell Aircraft system can be easily adapted to any aircraft equipped with standard Instrument Landing Systems without any extensive alterations, the only addition being a corner reflector, a triangular metal corner pan which enables the radar to more accurately pinpoint the landing aircraft.

New Deep-Draw Lubricant

A lubricant for "the deepest draws on the toughest metals," 700 Wax-Draw formulated by Johnson's Wax, will soon be commercially distributed.

The new product lubricates to 450 F and will handle pressures up to 200,000 psi. After drawing, it can be removed with the simplest cleaning operations, even hot water alone. A solvent bath, vapor degreaser, or alkaline washer also will remove the residue quickly. Parts are clean and ready for further operations immediately.

The new lubricant will continue to adhere to metal through multiple draws and may be rapidly diluted with water to any desired film thickness. Application is by roller coating, spraying, dipping, or by sponge.

Coated blanks may be drawn either wet or dry and thus the wax-coating process can be easily adapted to continuous press operations. Blanks can be fed into a roller coater, for example, and then run directly to the press operation, or they may be precoated, dried, palletized, then delivered to the press areas or to storage spaces. A film as clean as metal itself is left by 700 Wax-Draw.

One gallon of the new product, undiluted, will cover as much as 2000 sq ft of metal, and 4-to-1 dilutions produce excellent results.

"Universal" Adhesive

Eastman 910 Adhesive, a unique bonding material introduced as a laboratory curiosity only a year ago by Eastman Chemical Products, Inc., subsidiary of Eastman Kodak Company, is now solving a wide variety of difficult assembly problems involving the joining of almost every kind of material from minerals to rubber.

The new adhesive has made possible certain innovations in design which previously had been considered impractical if not impossible on a production-line basis. In other cases the basic design of the product itself depends on the use of the 910 Adhesive. It will be marketed by the Armstrong Cork Company.

The basic ingredient present in Eastman 910 Adhesive is a vinyl-type monomer that was first prepared several years ago in the Research Laboratories of Tennessee Eastman Company at Kingsport, Tenn. It is known chemically as methyl 2-cyanoacrylate.

In addition to the monomer, the adhesive contains a plasticizer to improve the flexibility of the bond, and a thickening agent to increase the viscosity for easier application.

The chemical reaction which occurs during bond formation takes place readily, especially in the presence of minute traces of moisture. The unset adhesive, however, may be exposed to the atmosphere for a period of several minutes to several hours without polymerizing or hardening. But, when spread or pressed into a thin film between two surfaces, bond formation is effected.

Radiation Dosimeter. Because of the fragile nature of the fiber, no prior adhesive provided the required combination of characteristics—ability to bond quartz fiber to aluminum, rapid set time, and sufficient conductivity—to permit commercial production of a direct-reading radiation-monitoring dosimeter pen.

Because of its high cost—$75 to $96 per lb—its use will be limited principally to those applications in which no other adhesive satisfactorily will perform the necessary job.

Some of the other potential applications of Eastman 910 Adhesive are: To bond gasket material; to eliminate

Vehicles Without Wheels

Air-pressure levitation is being studied at the Ford Motor Company as a means of support for high-speed ground transportation. "Fomotion" vehicles for public transportation would slide along steel rails on a film of pressurized air. These air supports, or "levapads," would not have the limitations of wheels and would permit ground travel in the 200 to 500-mph range.

"Glideair," a demonstration "smooth-road" vehicle, could operate on any surface sufficiently smooth for ordinary high-speed travel and would be supported by three circular levapads.

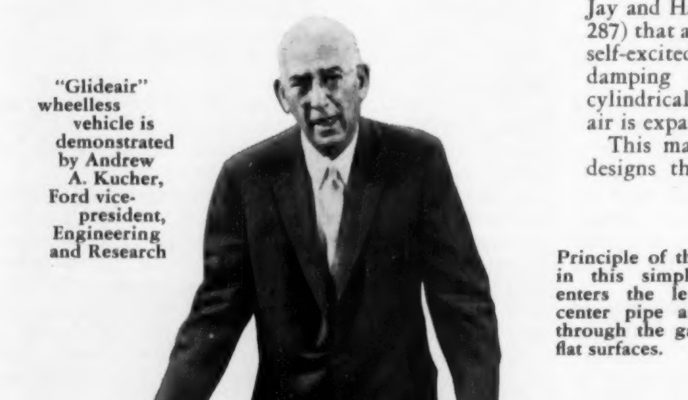
For rail application, a configuration combining several levapads would be used. One at the top of the rail would support the load, while two at the sides of the rail would prevent lateral motion, and another pair at the bottom would serve as grippers to prevent the "slipper" from leaving the rail. In operation, the air would pass from the outlet to the atmosphere, passing first between the rail surface and the bearing surface to serve both as cushion and lubricant. Pressures are low—usually ranging from 15 to 100 psi.

Although levitation was proposed as early as 1928 by A. A. Kucher, now vice-president of engineering at the Ford Motor Company, levapads are not necessarily stable under all conditions of operation, and this has been a major block in development.

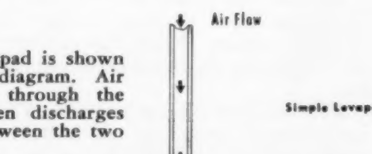
Criteria for determining stability characteristics have resulted from continuing research. It has recently been concluded, although not verified, from "An Analog Study of Levapad Stability" by Ford engineers David J. Jay and Harlan W. Peithman (ASME Paper No. 58—A-287) that an extremely small recess volume will eliminate self-excited vibration of the levapad entirely for suitable damping constants. The recess referred to is the cylindrical expansion chamber where the compressed air is expanded from the supply orifice.

This major technical advance has produced levapad designs that are stable for all requirements. Studies

"Glideair" wheelless vehicle is demonstrated by Andrew A. Kucher, Ford vice-president, Engineering and Research



Principle of the levapad is shown in this simplified diagram. Air enters the levapad through the center pipe and then discharges through the gap between the two flat surfaces.



Strain Gages. All available types of strain gages—phenolic, paper, and epoxy-backed—can be cemented with Eastman 910. It is particularly valuable for the SR-4 type. Phenolic gages are good up to 225 F, paper and epoxy-type to 175 F when used for short-duration tests.

Impact Resistance. Plastic-handled hammers with steel forged heads attached with Eastman 910 adhesive withstand 300,000 hammer blows, three times the use of a normal hammer. Small Fiberglas handles have 5 to 50 times greater strength than that of the standard-size hickory-wood handle.

screws and other fastenings in mounting hearing-aid components inside the case; to fasten instrument parts where other methods of assembly are not feasible; to seal bolts and nuts; to attach wire bores to glass tubes; to assemble jigs, fixtures, and molds, thus eliminating soldering, welding, rivets, nuts, and bolts; to secure two odd-shaped parts together for subsequent operations such as machining, drilling, or welding; to fabricate and repair wind-tunnel models; to adhere small electronic components; to cement magnetic assemblies; to fabricate and assemble prototype models and laboratory apparatus; and to bond turns of insulated wire coils.

made with oscilloscope traces indicate the conditions under which stability can be achieved.

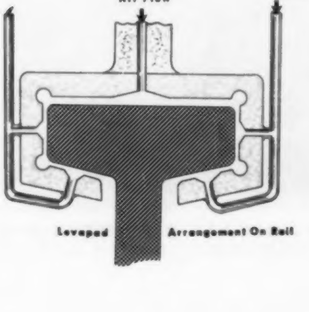
The company feels that research has developed the concept to the point where its feasibility is proved and it can be proposed for a full-size vehicle. "It probably will replace nothing," a company spokesman has stated, "but instead will add a mode of its own that will help make travel more comfortable, safer, and still more economical than it is today."

A 16-passenger luxury bus supported by levapads and operating on a single rail located on the ground has been projected by company designers. It would be powered by two turbojet engines which would supply both compression and propulsion power, and would be capable of making the 272-mile trip from Detroit to Chicago in less than one hour.

The smooth-highway vehicle would have three levapads, each mounted on spherical bearings that permit the levapads to adjust to the contours of the highway. Jets of air through tiny holes in the levapads supply pressure to levitate the vehicle. Breaks in the surface are no obstacle since levapads will jump a 1-in. space without difficulty.

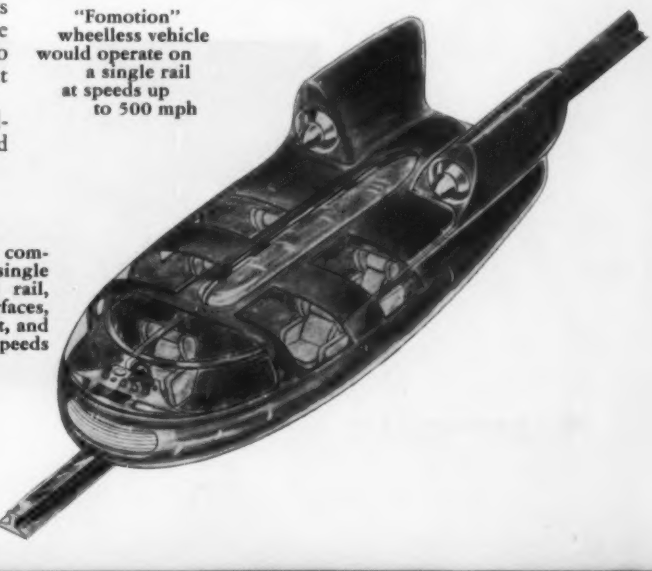
Considerably less power would be required for levapad-equipped vehicles than is needed to move wheeled vehicles at speeds above 150 mph. In comparison with a modern 4-engine passenger plane with a take-off weight of 50 tons, a levitated ground vehicle requires much less power. Where 9600 hp are required to operate the airplane, only 2500 hp would be required for levitation and another 1800 hp for propulsion of the ground vehicle at 400 mph. The requirements for the ground vehicle are thus less than half those for the aircraft.

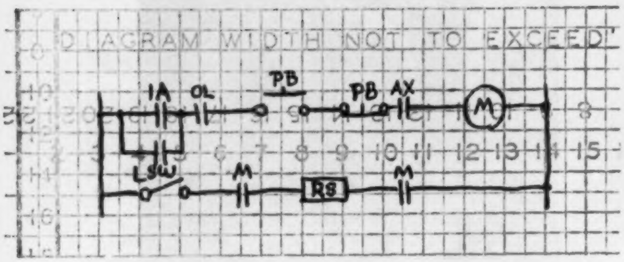
Speeds of 200 mph are the maximum considered practical for wheeled vehicles. Speeds of 185 mph are attained at the Indianapolis races but require at least one pit stop during a race for new tires. Vibration, loss of traction, and loss of control are among the problems of high wheel speeds.



Five levapads provide complete clamping with a single shoe on a standard rail, serving as bearing surfaces, cushions, and lubricant, and permitting higher speeds than wheels

"Fomotion" wheelless vehicle would operate on a single rail at speeds up to 500 mph





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Simplified Drafting

The only drawing required in the simplified-drafting technique is a free-hand sketch of the circuit, *above,* on special cross-section paper. Using this, the *Fotosetter operator,* 1, types out the circuit except for the nomenclature. *Matrices,* 2, contain small photographic negatives of the symbols which the *Fotosetter,* 3, exposes in sequence onto photographic film at the rate of 480 characters per min. This developed film is inserted in a special roller-type *copyholder,* 4, where a pointer moves from left to right permitting the operator to accurately position nomenclature, wire identifications, and notes on a second film. This *film is overlaid,* 5, on the other film. The *result,* 6, is a clear, well-ordered diagram on an 8$^1/_2$ × 11-in. sheet, $^1/_4$ the size of previous standard diagrams.

A MECHANICAL PROCESS which eliminates tedious hand drafting of electrical-circuit diagrams has been developed by General Electric Company's Industry Control Department, Roanoke, Va. The process can be adapted to other forms of drafting.

The engineer simply makes a free-hand sketch of the circuit on specially prepared $^1/_4$-in. cross-section paper which emphasizes every other line. This ruling provides a unit system for the engineer to locate the various symbols and circuit connections, as well as all nomenclature and other identifying information.

A keyboard-operated Fotosetter Line Composing Machine made by Intertype Company, Brooklyn, N. Y., is used to produce the diagram. The ruled lines on the

Insulating-Cement Thermal Barrier

THE insulation of irregularly shaped high-temperature surfaces is a common problem facing the power engineer. Insulation of a steam turbine for example requires an efficient insulating material which is capable of withstanding the high temperatures and can easily be applied to the irregular shell surfaces. The temperature variation in the different zones of the turbine makes an insulator economically desirable whose thickness can be conveniently varied according to surface temperature.

No. 1 Cement, a spun-mineral-wool insulating cement with a maximum-service temperature of 1800 F manufactured by Baldwin-Hill Company, Trenton, N. J., answering all these requirements was used to insulate the General Electric turbine driving the new 175,000-kw generator recently installed at Philadelphia Electric Company's downtown Schuylkill Station.

The mineral-wool cement was built up around the high-pressure shell of the turbine in successive 2-in. layers until the required thickness was reached on each section. On the high-pressure shell the total thickness of the cement varied from 10 in. on the hottest, 1050-F, part to 7$^1/_2$ in. on the coolest, 800-F, section. The cement was reinforced with 1-in-mesh galvanized woven-wire netting secured by multiple tie wires.

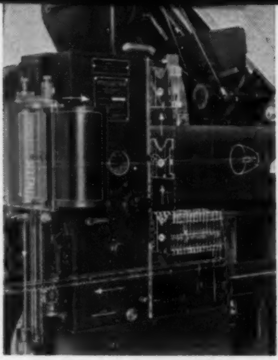
Utility-Built Gas-Cooled Reactor

THE Philadelphia Electric Company and more than 40 other utility companies, newly organized in a nonprofit group representing all sections of the United States, have offered to develop and build a 40,000-electrical-kw, high-temperature, helium-cooled, graphite-moderated, nuclear plant in response to AEC's invitation to industry to be located on the Company's system by late 1962 or early 1963.

The plant is designed to operate at 1000 F and 1450 psi using graphite-canned fuel elements. With an initial loaingd of metallic-clad fuel elements, used to meet the AEC time limitations, the plant will first produce about 30,000 kw of power from steam at 850 F and 850 psi.

The system that would be used has been under intensive theoretical and experimental development with private

Insulation in progress on the Philadelphia Electric Company's Schuylkill Station



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forms are also numbered to provide a ready reference for the Fotosetter operator in setting the elements of the circuit in position. The operator "types out" each line of the circuit, which causes circulating brass matrices to fall in place. Each matrix contains a film negative of the image of an electrical symbol and its connection points. These are individually exposed onto a film positive row by row, with the film advancing until the entire circuit has been printed.

Lettered information is set separately in the proper position, also by photo composition, and printed on another film positive. After both have been developed, they are combined and overlaid with a third film containing the title blocks. This positive sandwich is then used to make the final print by either contact printing or enlarging.

To make corrections, sections are merely cut out of the film with a special cutting device. After setting the correction on the Fotosetter it is taped into the proper place.

General Electric has found that the sharpness, clarity, and orderliness of circuits prepared in this manner allows the final size of the diagram to be much smaller than that of prints reproduced from hand drafting. This reduces the cost of reproduction and eliminates the problem of folding and binding larger size sheets. Also, the $8^1/_2 \times 11$-in. master-film positives are readily stored in file folders.

funds by the General Atomic Division of General Dynamics Corporation for the past two years.

The Bechtel Corporation will be the engineer-constructor, General Atomic Division of General Dynamics Corporation will be responsible for the nuclear portion of the plant, and Westinghouse Electric Corporation will be responsible for the plant's electric-generating system, including the turbine and associated equipment.

Construction cost would be $24.5 million. The offer of the utility companies to build the developmental prototype plant is contingent upon AEC agreement to contribute an amount not to exceed $14.5 million to further research and development costs.

As stated in the proposal, this type of reactor is particularly advantageous for large-size nuclear power units because of the increased efficiency of the graphite moderator in larger core sizes. Hence, the potentially long fuel burnups, low fuel-cycle costs, and relative insensitivity to fuel-reprocessing charges can be realized at the higher power levels.

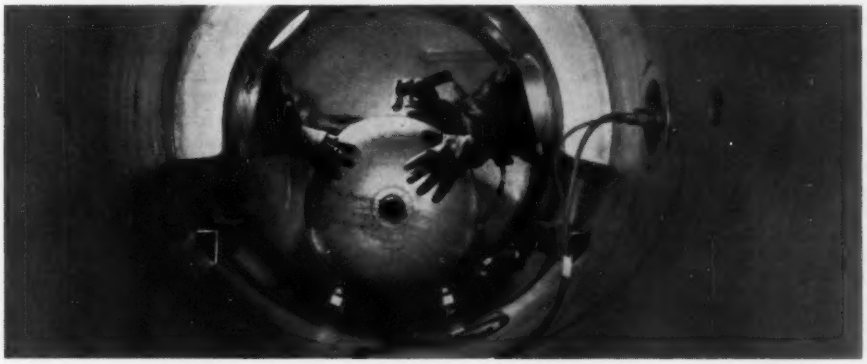
Studies have indicated that such a 325,000-kw plant would be economically competitive with conventional power in many areas of the United States at present costs.

The 40,000-kw plant is fully adequate in size and design to demonstrate and evaluate the technological and economic features of this concept without additional or intermediate-scale prototypes.

Tantalum Process Reactor

A TANTALUM-LINED reactor useful in the chemical, food-processing, pulp and paper, and atomic-energy fields has been developed jointly by The Pfaudler Company, a division of Pfaudler Permutit Inc., and Haynes Stellite Company, a division of Union Carbide Corporation.

The new 30-gal reactor is designed to operate at 650 F and 500 psi. Reactor chamber consists of a Haynes 0.030-in. tantalum liner with a $^5/_8$-in. outer shell of type 430 stainless steel. All surfaces that contact the product are tantalum, including a turbine-type, tantalum-sheathed agitator shaft, solid tantalum agitator and baffle, and tantalum immersion-type bayonet heater. Total vessel weight without drive is about 700 lb.



The tantalum reactor is welded in a specially constructed "vacuum purge" tank by the tungsten-arc inert-gas process

PROGRESS ON SPECIFIC REACTOR TYPES
Power Reactor Projects and Design Studies

Reactor	Station electrical output, mw	Status	Country
Nonboiling H_2O			
Shippingport	60	Operating	USA
Yankee	134	Constructing	USA
Consolidated Edison (Indian Point)	275	Constructing	USA
APPR-1	2	Operating	USA
Savannah Ship	20,000 shp	Constructing	USA
Voronezh-PWR	420	Constructing	USSR
Leningrad-PWR	420	Planned	USSR
Soviet-PWR-Mobile	2	Constructing	USSR
Icebreaker Lenin (3 reactors)	66,000 shp	Constructing	USSR
Emigrant Ship	180 (thermal)	Design study	Japan
Submarine Tanker	180 (thermal)	Design study	Japan
Boiling H_2O			
BORAX-IV	3.5 (max.)	Operating	USA
EBWR	5	Operating	USA
VBWR	5	Operating	USA
Dresden	192	Constructing	USA
Elk River	22	Planned	USA
Northern States	62	Planned	USA
Pacific Gas and Electric	50	Planned	USA
Soviet BWR	50	Constructing	USSR
Belgonucleaire IC-BWR	129	Design study	Belgium
Graphite-Moderated, Gas-Cooled			
Calder (2 reactors)	92	Operating	UK
Calder B (2 reactors)	92	Operating	UK
Chapelcross (4 reactors)	182	Constructing	UK
Berkeley (2 reactors)	332	Constructing	UK
Bradwell (2 reactors)	352	Constructing	UK
Hunterston (2 reactors)	344	Constructing	UK
Hinkley Point (2 reactors)	626	Constructing	UK
UK-AGR	28	Planned	UK
UK-HTGR	10 (thermal)	Planned	UK
ORNL-GCR	252	Design study	USA
K-ACF-GCR	253	Design study	USA
G-1	5	Operating	France
G-2	30	Constructing	France
G-3	30	Constructing	France
Fast Reactors			
EBR-II	20	Constructing	USA
Enrico Fermi	104	Constructing	USA
Dounreay	15	Constructing	UK
BR-5	5 (thermal)	Operating	USSR
BN-50	50	Planned	USSR
BN-250	250	Planned	USSR
Sodium-Graphite			
SRE	6	Operating	USA
Hallam-SGR	75	Planned	USA
Soviet-SGR	50	Constructing	USSR
Graphite-Moderated, H_2O-Cooled			
APS-1 Obninsk	5	Operating	USSR
Soviet-Ural (4 reactors)	400	Constructing	USSR
Soviet-Siberia (6 reactors)	600	Operating	USSR
Organic-Moderated			
OMRE	15 (thermal max.)	Operating	USA
Piqua	12	Planned	USA
Homogenous Aqueous			
HRE-2	5 (thermal max.)	Operating	USA
Pennsylvania Advanced Reactor[a]	150 (max.)	Planned	USA
Czech-H_2O	10	Planned	Czechoslovakia
Soviet-D_2O Boiling	35 (thermal)	Constructing	USSR
Dutch-H_2O	0.25 (thermal)	Constructing	Netherlands
D_2O-Moderated and Cooled			
NPD	20	Constructing	Canada
CANDU	200	Design study	Canada
Carolinas-Virginia	17	Planned	USA
Sulzer	30 (thermal)	Design study	Switzerland
Halden	10 (thermal)	Constructing	Norway
D_2O-Moderated, Gas-Cooled			
DM-GCR	50	Planned	USA
Czech-GCR	150	Constructing	Czechoslovakia
D_2O-Moderated, Sodium-Cooled			
Chugach	10	Planned	USA

[a]Terminated, AEC Release, Dec. 16, 1958.

Power Reactors

As a result of the Second International Conference on the Peaceful Uses of Atomic Energy, a large amount of information has been published which describes the status of almost all power reactors currently in operation, under construction, or in advanced stages of design.

The quarterly publication *Power Reactor Technology*, prepared for the Atomic Energy Commission by General Nuclear Engineering Corporation, contains a review of their status and a table (vol. 2, no. 1, Dec., 1958).

Of the reactor types listed, the report states, there are two which are represented by enough operating reactors and reactor designs to be considered for the present as more or less standardized, with characteristics which vary but over a fairly well-defined range.

These are the pressurized H_2O reactors (boiling and nonboiling) and the gas-cooled natural-uranium graphite-moderated reactors. The information presented by the USSR at the Conference has introduced a third type, the water-cooled graphite-moderated reactor, which promises to be an important one.

It is perhaps reasonable to say that these three reactor types—H_2O-cooled and moderated, gas-cooled graphite-moderated, and water-cooled graphite-moderated—have achieved economic acceptance. This is not intended to imply that they are competitive with fossil-fuel power plants; rather they have been built in large sizes, and their performance has been encouraging enough to justify the commitment of large sums of money for the construction of further large-scale plants of this type.

Nuclear Progress in 1958

The United States completed 37 nuclear reactors in this country and abroad during 1958, according to a year-end report by the Atomic Industrial Forum.

These included engines for the submarines *Swordfish* and *Sargo*, a dual-reactor land-based prototype of the atomic power plant for a large naval surface vessel, a single-reactor land-based prototype for an advanced atomic submarine engine, and a ground-test experiment of a nuclear reactor designed for rocket propulsion.

Also completed were a small, transportable reactor to produce both electric power and heat for remote Army bases, two large reactors for testing material and fuel components, one small power experiment, and 27 relatively small research and training devices.

During 1958 the U. S. began construction on 45 reactors in this country and abroad, including two reactors for consumer electric power in Nebraska and Minnesota, a small electricity and space-heat reactor for an Army post in Alaska, 13 reactors to propel submarines, an atomic engine for a naval destroyer and a land-based prototype for the destroyer engine, three large test reactors, and two small power-experiment reactors.

New contracts were received for the construction overseas of three reactors to produce electric power, including a large reactor to be built for the Italian government with World-Bank financial assistance and two smaller reactors for Cuba and West Germany.

Eight new U. S. uranium-ore mills were completed, at least 39 particle accelerators sold, large radiation sources were acquired by five industrial companies, a major facility for the experimental preservation of food through irradiation was contracted for, and two new facilities for nuclear-reactor fuel were completed.

Nuclear Briefs

▶ SPERT-III Achieves Criticality

THE Special Power Excursion Reactor Test No. 3, SPERT-III, a versatile $3.5-million highly enriched uranium-fueled research facility developed for studying nuclear reactor safety, achieved criticality in December, 1958, at the Atomic Energy Commission's National Reactor Testing Station near Idaho Falls, Ida.

SPERT-III is one of a series of reactors designed and developed by Phillips Petroleum Company as part of the AEC's program to find basic explanations for reactor behavior under runaway conditions. All operations are conducted remotely since tests approach reactor destruction. The reactor and coolant system are designed to be operated from a control center one-half mile away. This facility provides the widest practical range of control over three variables—temperature, pressure, and coolant-flow rate. The plant is expected to contribute significantly to a better understanding of reactor self-limiting and occasional instability characteristics exhibited in more than 750 excursions in SPERT-I.

SPERT-II, still under construction, will continue the same type of studies initiated by SPERT-I but with special emphasis on how various moderators and reflectors, including heavy water, influence reactor behavior.

Although SPERT-III is classified as a high-pressure, high-temperature, light-water-moderated-and-cooled reactor, its versatility will enable the performance of transient tests under various initial conditions of pressure, temperature, and coolant flow. Pressures ranging from atmospheric to 2500 psi, and water temperatures from 68 to 668 F are attainable in the complex facility. Also, coolant-flow rates range from zero to 20,000 gpm, with heat-removal capacities up to 60,000 kw for a duration of 30 min. SPERT-III can be used, therefore, to investigate conditions applicable to many reactor fields, including both pressurized and boiling-water power reactors.

▶ Brookhaven Medical-Research Center

The nation's newest atomic medical-research center, including the first nuclear reactor designed specifically for medical use, has been dedicated at Brookhaven National Laboratory, Upton, N. Y., and is scheduled for operation early this year.

In addition to the 1000-kw water-cooled-and-moderated reactor, the new 110,000-sq-ft $6.5-million Brookahaven Medical Research Center includes a 48-bed hospital for research patients, and laboratories for studies on medical applications of atomic energy.

▶ Pennsylvania-Advanced-Reactor Project Ends

The Pennsylvania Power and Light Company and the Westinghouse Electric Corporation have withdrawn their proposal to build a large-scale aqueous-homogeneous nuclear power plant under the AEC's Power Demonstration Reactor Program. Accordingly, negotiations between the AEC and the companies on a contract under which the AEC would offer research and development and other assistance to the project have been terminated.

Under the proposed contract, a decision would have been made about the end of 1959 on whether to construct the plant or discontinue the project, based on results of the research achieved by that time.

The cost to the companies and the AEC of the project would have been an estimated $108 million.

▶ Reactor-Supervisor Training Program

The first class in a training program to be conducted by the Duquesne Light Company for the AEC at the Shippingport Atomic Power Station for supervisory personnel of domestic and foreign organizations began in January. The six-month course is intended for those engaged in or planning the design, construction, or operation of nuclear power plants. There will be 25 participants enrolled every three months. The AEC will invite American and foreign organizations engaged in or planning nuclear power plant projects to participate. Tuition charge is $2000 to cover associated operating costs.

Entrance requirements include a college degree in engineering or science, or equivalent training, and ability to speak and comprehend the English language. The equivalent training must include knowledge of engineering physics, mathematics through simple differential equations, chemistry, atomic physics, thermodynamics, and fundamentals of electricity.

▶ Oxide-Fuel-Cycle Development Program

The AEC will award a cost-type contract for research and development work and for the design of a fast-breeder reactor using a plutonium-oxide uranium-oxide fuel cycle. The work is expected to require a minimum of 18 months for completion, and the contract is awarded on the basis of eight proposals received from industry. The objective is to lower the cost of electric power from fast-breeder-reactor power stations, primarily by reducing fuel-cycle costs.

Preliminary research conducted at the AEC's Knolls Atomic Power Laboratory indicates that economic nuclear power may be achieved from fast-breeder reactors with long-lived oxide fuel elements and low-cost fuel-fabrication and reprocessing methods.

Projects in the AEC's fast-breeder reactor program include two experimental breeder reactors at the National Reactor Testing Station in Idaho, one of which is under construction, and research and development assistance to the Enrico Fermi Atomic Power Plant in Monroe, Mich.

▶ Research Reactors for Export

Westinghouse International Company will export a complete line of research, training, and educational nuclear reactors manufactured by Aerojet-General Nucleonics of San Ramon, Calif., in foreign markets except the United Kingdom.

The distributor agreement has been signed covering all six of Aerojet-General's reactor models—from the smallest subcritical unit to a large material-testing unit with 10,000-kw thermal output. Aerojet will assist in training customer personnel to operate the units.

Larger models in the line are designed for advanced work and production of radioisotopes in quantity for medical and industrial purposes.

These smaller reactors require no special electrical-distribution facilities. They can, in effect, be "plugged into the nearest outlet."

PHOTO BRIEFS

1 Wind-Tunnel Compressor. Nearly 1,000,000 cfm of "dead air" will be drawn from around the edges of the wind-tunnel test section of the NASA Langley Research Center in Virginia. This will eliminate the friction and small eddy currents at the edges and permit smooth flow across the complete width of the air stream. A step-up gear in the Westinghouse compressor raises the 565-rpm speed of the 35,000-hp motor to the 2290 rpm of the compressor. The 16-ft transonic tunnel will test aircraft models at 460 to 860 mph.

2 Reactor Pressure Vessel. A 95-ton, 33-ft-high, 94-in-ID pressure vessel is being tilted into an upright position inside the 85-ft-high, 70-ft-diam, vapor container for the Westinghouse Testing Reactor under construction at Waltz Mill, Pa., for fuels and materials development. A high-density $7\frac{1}{2}$-ft-thick concrete shield will permit personnel to work safely in the vicinity of the reactor.

3 Motorized Small-Parts "File." Parts are automatically brought to the assembler with motorized Diebold, Inc., office files. These have been fitted with 32 small-parts baskets arranged in eight levels in assembly sequence. In place of searching among scattered baskets formerly placed on the work bench, **left photo**, the operator touches a foot control which brings the needed parts to work-bench level. Parts also accumulate less dirt than when sitting in the open.

4 Sprayed Tungsten-Carbide Facing. A deposit efficiency of better than 90 per cent, with coating speeds of 110 to 150 sq ft per hr for 0.001-in. thickness is attained with a new spray-powder tungsten-carbide material developed by Metallizing Engineering Company, Inc., Westbury, N. Y., for use with the Metco ThermoSpray Gun. Any required thickness may be applied and torch-fused to produce a comparatively smooth surface which minimizes finishing operations. The unit requires no compressed air, operates on oxygen and acetylene, and may be hand-held or machine-mounted.

5 "Inspector's Friend." A 3-ft-high battery-operated fumeless personal utility car manufactured by The Long Company, Oak Hill, W. Va., will transport workers and light supplies at 4 mph in the limited space of mine tunnels.

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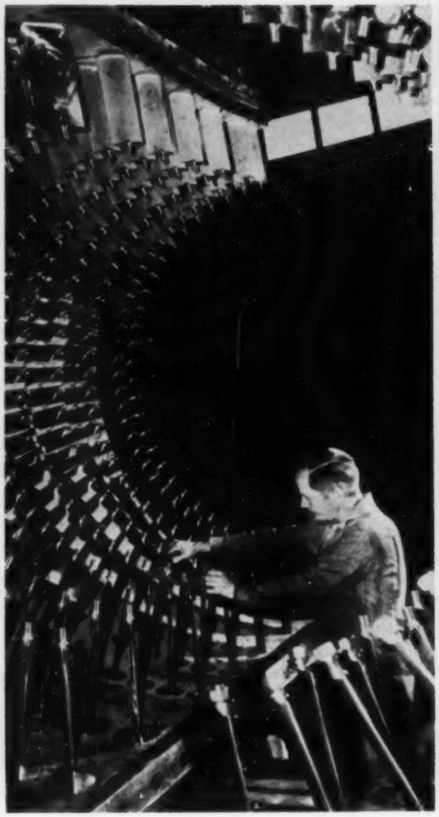

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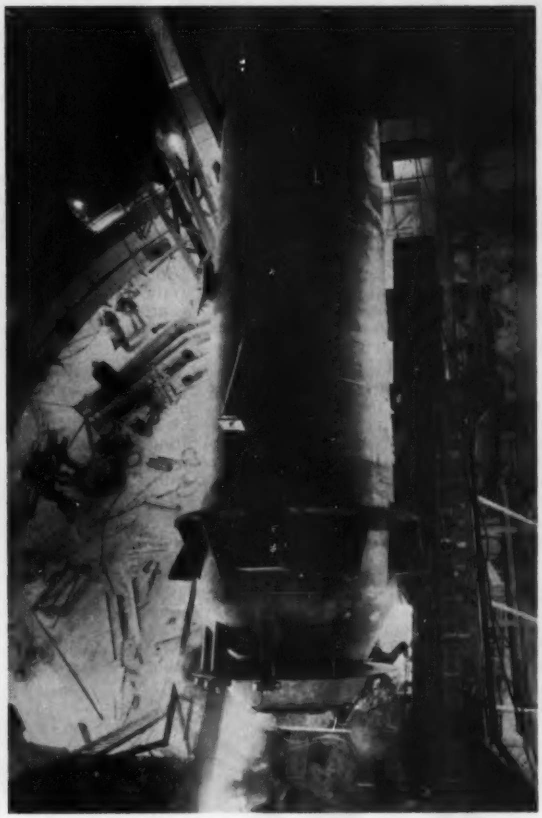

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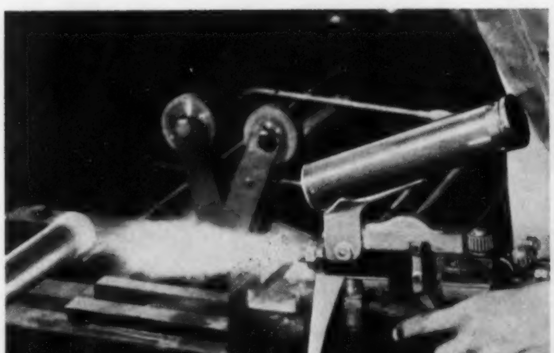

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PHOTO BRIEFS

6 Yankee Atomic Reactor. Construction forces of Stone & Webster Engineering Corporation place 100 tons of reinforcing steel around the base of the concrete reactor housing for the Yankee Atomic Electric Company's reactor which will be enclosed in a 125-ft-diam steel sphere.

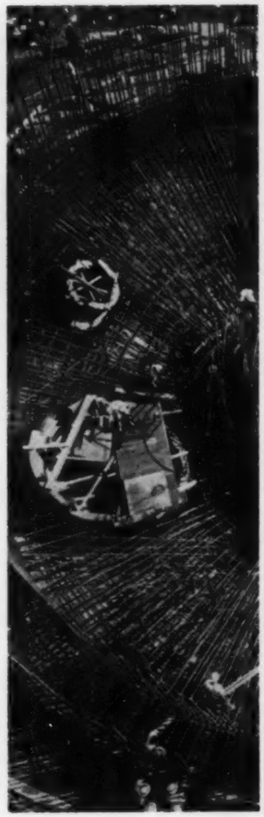
7 Automatic Riveting. Each of four 21-ton riveting machines built by Nuclear Products—Erco Division of ACF Industries, Inc., to Convair specifications performs a complete riveting operation every $3^1/_2$ sec. Used on production-line fabrication of wing and fuselage panels for the Convair 880 and 600 jetliners, the machines drill, countersink, and counterbore a hole, insert a rivet, exert 15,000 psi, and then shave off the head to a flushness of up to 0.0015 in.—permitting a wing-surface smoothness previously unattainable with high-speed production-riveting equipment.

8 Sharp Bending of Titanium Tubing. Grade A-40, soft-annealed, commercially pure titanium tubing made by Superior Tube Company, Norristown, Pa., with 0.750-in. OD and 0.035-in. wall thickness, for example, has been bent to a 90-deg angle on a 0.750-in. radius. Kreisler Industrial Corporation, Paterson, N. J., draws the tubing around a rotating bending form. It is held in position under proper pressure and supported by special moving clamps, dies, and mandrels. Wrinkling is minimized and annealing or stress relieving is usually unnecessary.

9 Flame-Cutting Output Boosted With Powder. Adding special Oxweld No. 200 iron powder to the oxygen cutting flame of an automatic machine developed co-operatively by Linde Company, Division of Union Carbide Corporation, and Pittsburgh Steel Company has boosted output and slashed production costs. The push-button-controlled machine cuts 1000 $3^1/_2$ to $7^1/_2$-in-diam billets every 8-hr shift.

10 Camera for Mach 35 Speeds. Ideally applicable to high-speed aerodynamic studies, thermal-barrier studies in ballistic investigations (such as nose-cone re-entrance problems), for hypersonic wind-tunnel instrumentation, and other applications having object velocities up to Mach 35 is a camera made by Beckman & Whitley, Inc., of San Carlos, Calif. Splitting the light beam into two parts permits the Model 192 to operate with no blind time. It records 82 35-mm frames in a 55-microsec period with standard daylight-loading cassettes (nearly 1,500,000 frames per sec) and sells for $69,500.

11 Instrumentation for Space Probe. A photoelectric sensor in the Pioneer III, small enough to fit in the palm of the hand, was attached to the bottom of the payload and would look back on the moon as it passed. The lens in the barrel was shielded from sunlight and twin apertures were positioned so that the far-off earth would be too small an image to trigger both photoelectric cells at once. Only the moon's image could do that if the vehicle approached within 22,000 miles. The probe would then have sent a signal back to earth announcing this. Although Pioneer III did not reach its destination, the instrumentation provided Caltech Jet Propulsion Laboratory and NASA with much-needed information on its two passes through the high-level-radiation belt.



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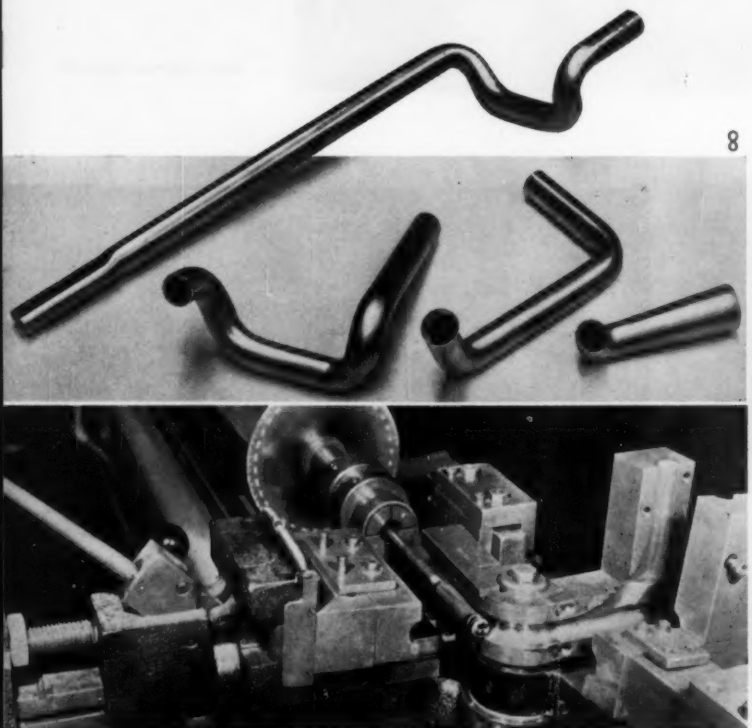

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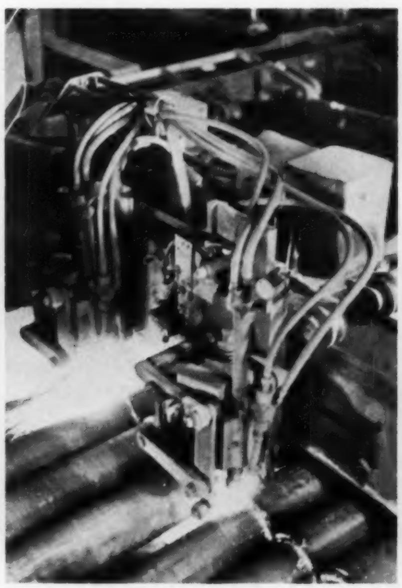

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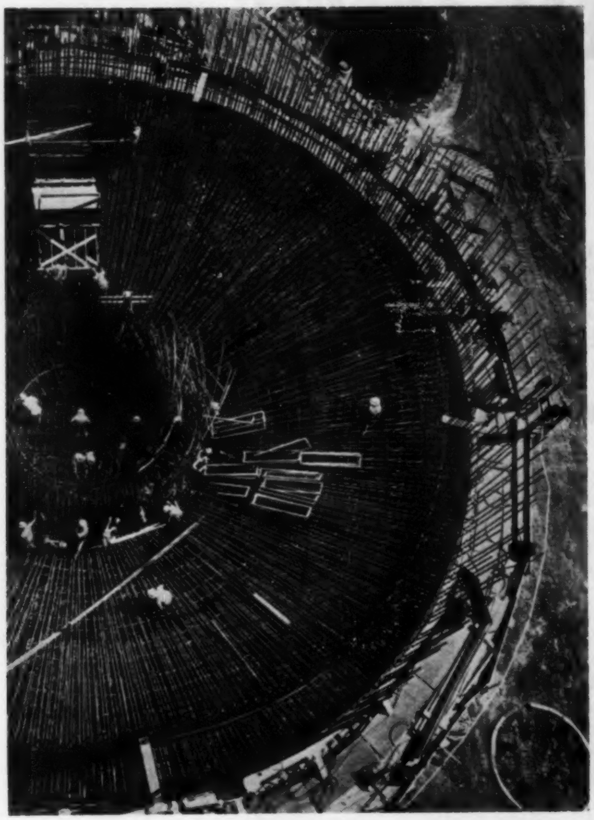

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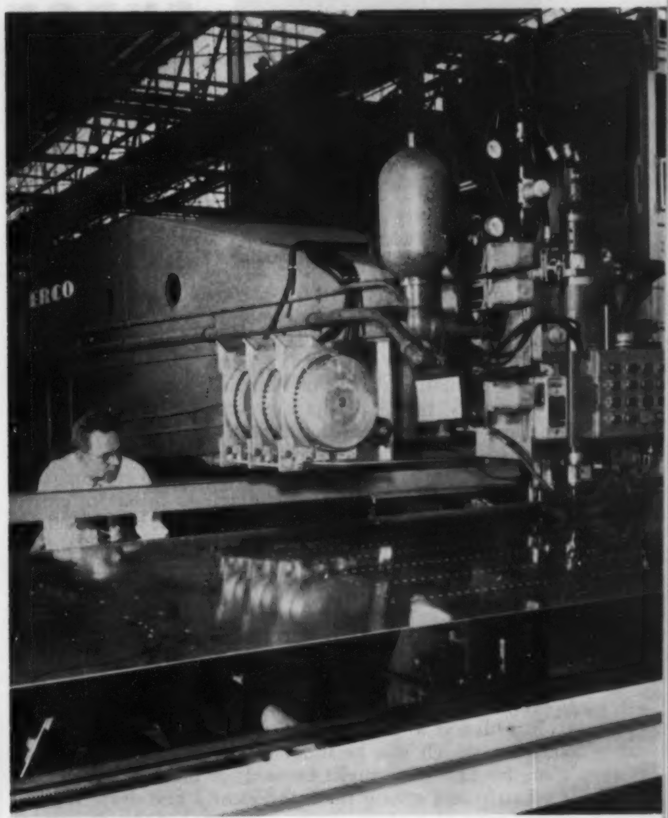

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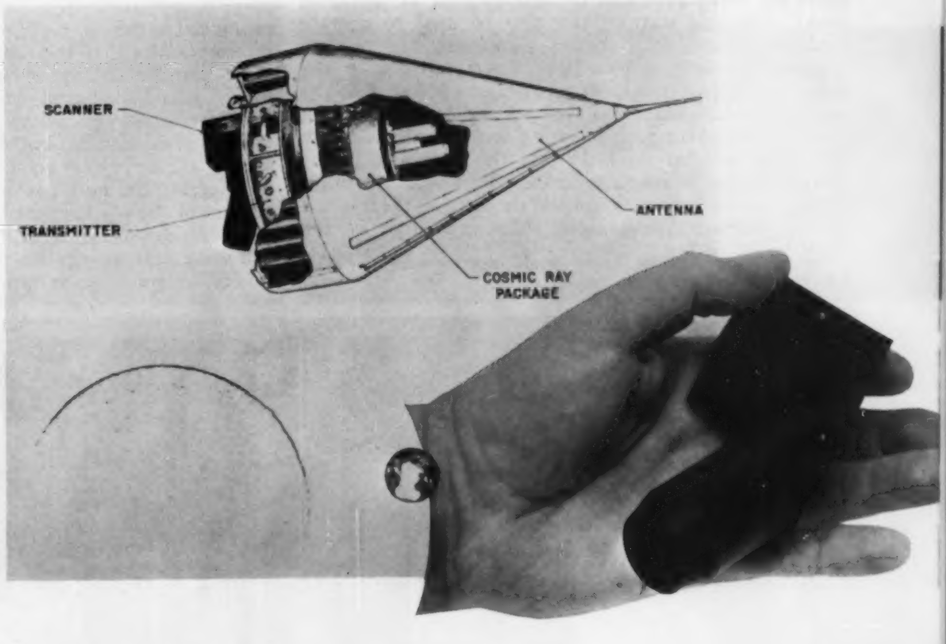


Engineering Progress in the British Isles and Western Europe

J. FOSTER PETREE
European Correspondent

EUROPEAN SURVEY

Italian Rotary-Transfer Press

A FORM of rotary-transfer press for producing from strip such components as automobile head-lamp holders, and possessing somewhat exceptional adaptability, has been produced by an Italian firm, Costruzioni Meccaniche Benelli-Gavazzi, of Florence, Italy. It is made in five sizes, ranging from a pressure of 16 tons in the smallest to 130 tons in the largest, with speeds from 70 to 30 strokes per min, respectively. The frame is made of box-section iron castings, bolted together, and the ram reciprocates on four large-diameter pillars of chromium-plated steel. The drive is by constant-speed electric motor (or a variable-speed P.I.V. gear, if this is required) through an electrocompressed air clutch and gearbox to either one or two crankshafts, according to the size of the machine, which are located in the base and operate the ram by either two or four connecting rods. Transfer of the components from station to station is effected by gripping fingers actuated by cams. Indexing is by a drive from the crankshaft.

In addition to the rotary table, the press has two side stations which can be used for a variety of purposes. One, for example, might be used for blanking from the feed strip and giving the component a first draw while, if the parts to be formed are relatively simple, the other station may be doing the same to a second strip for a different component, so that two completely different parts are being produced on the machine at the same time. The side stations can also be used to operate auxiliary drives, coil feeders, and such, to provide staggered feeding, or to actuate a scrap cutter. If the sequence requires it, a component can be inverted on the transfer table. Magazine feeding can be employed if desired—for instance, if operating on components partly formed on another machine; but the main idea in the design was to produce a machine which would perform all the necessary operations from the strip to the finished article without intermediate handling, and as the number of stations may be as many as 24, this will probably be possible in a majority of cases. The presses are distributed in Western Europe (excluding France) and in America by K. S. Paul, Ltd., Great Western Trading Estate, Park Royal Road, London, N. W. 10, England.

Windmill Generator

IN THE "European Survey" which appeared in MECHANICAL ENGINEERING of July, 1955, a description, with illustrations, was given of a windmill generator in which the rotary movement of the two large airfoil-section blades expelled air from the tips of the blades, which were hollow, thus producing a partial vacuum in the cylindrical supporting tower, which contained an air turbine directly coupled to a generator. Air was therefore drawn in through the turbine. The design originated with a French engineer named Andreau and was developed by Enfield Cables Ltd., London, England, in conjunction with De Havilland Propellers Ltd., who made the blades, and the English Electric Company, who supplied the turbine and generator. Shortly after this description appeared, the unit was dismantled (it had been erected only temporarily, for tests) and was shipped to Algeria, having been acquired by Electricité et Gaz d'Algérie, of Algiers, for re-erection in North Africa. There, about 15 months ago, it was installed on a site near Algiers where high winds are frequent, and a prolonged series of tests was undertaken. The latest information is that these have been notably successful, the Research Department of Electricité et Gaz d'Algérie having established that, though designed for only 100-kw output, it was capable of giving 130 kw and even more, and of maintaining this output in what was described as "a very irregular wind." Since it was erected in Algeria, the mill has been fitted with a modern version of the old-fashioned windmill "fantail," to turn the head automatically into the direction of the wind, and with gear to regulate the angle of incidence of the blades in response to variations in the wind speed.

Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

Rotary-transfer press produces such components as automobile head-lamp holders from strip

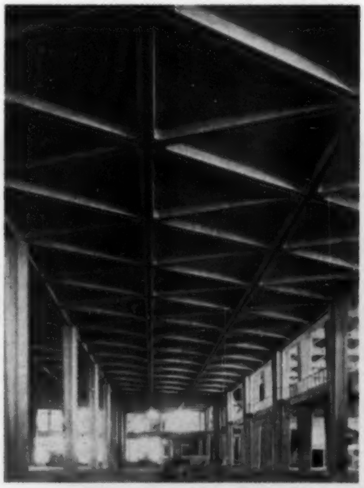
Shell-Roof Exhibition Hall for Paris

French constructional engineering has always been marked by boldness and originality, and this has never been better exemplified than by the new exhibition hall recently brought into use in Paris by the Centre National des Industries et des Techniques. Triangular in plan, it consists of a double shell roof covering a floor area of 226,000 sq ft and supported only at three points at the apexes of an equilateral triangle. There are no interior supports whatever, and the shell is not even stiffened by internal ribs or arches. It is situated at the Rond-Pont de la Défense on the Avenue de Triomphe, the main route from Paris to Saint Germain, and has been completed in 21 months from the start of work on the site.

Three firms of civil-engineering contractors participated in its construction, the details of which were described in London on December 4, 1958, in a paper by Nicolas Esquillan, technical director of one of the firms, the Société des Entreprises Boussiron, delivered at a joint meeting of the Société des Ingénieurs Civils de France (British Section) and the (British) Cement and Concrete Association.

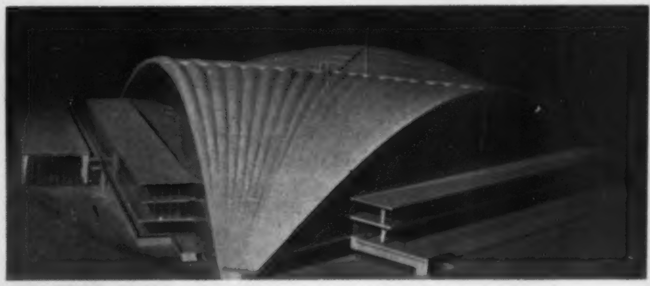
The base of the structure is an equilateral triangle with sides 715 ft in length, which is roughly equal to the width of the Place de la Concorde, and the radius of the shell roof 1378 ft. It rests at the angles on concrete piers 20 ft high, on foundations extending about the same amount into the ground. The floor consists of triangular precast slabs resting on main beams of 39 ft to 46 ft span, supported on columns in the form of truncated pyramids on rectangular bases. The main floor area is 124,000 sq ft, and the construction of this was completed and the surface carefully leveled before any work was done on the erection of the shell roof. This was an important feature in the planning of the constructional work, because it would have been quite impracticable to erect falsework to carry the whole roof at once. Instead, tubular scaffolding was used on three sections extending from the three supporting piers to the center of the dome. On these scaffolds three narrow strips of the roof were constructed, forming, as it were, an open cage. The scaffolds were then divided and the halves moved apart over the floor until they were in position to support adjacent strips, cast onto the sides of the three original portions. This process was repeated, the sections of roof being thus gradually widened until they met and the whole floor area was under cover. The method greatly reduced the quantity of tubular scaffolding needed, but even so it amounted to some 920,000 linear feet.

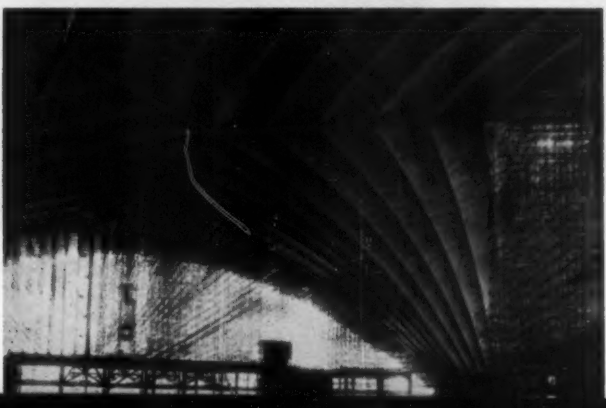
As stated, the shell is double. The upper layer was cast on forms made of cement-impregnated fiberboard. The maximum thickness of concrete in the shells is only $2^1/_2$ in. The space between them is filled with a thermal-insulating material. The roof is watertight by reason of its construction, the concrete having been vibrated to increase its compaction and covered with cement, carefully smoothed on; but, to make its watertightness more certain, it is also coated on the outside with a polyester-base paint. The vertical sides of the structure consist of panels of tempered plate glass, supported in metal frames. The designers claim that this remarkable building establishes two world records in having the largest surface supported at a single point (75,000 sq ft) and the longest known span for a thin-shell vaulted structure—676 ft at the façades and 780 ft at the groin.



Underside of floor for shell-roof exhibition hall consists of triangular precast slabs

Shell-roof Exhibition Hall at the Rond-Point de la Défense, Paris, is shown in model





Interior view of shell-roof exhibition hall under construction. Nearly 175 miles of tube is used in scaffolding.

Substance in Brief of Papers Presented at ASME Meetings

M. ZANFARDINO
Staff Editor

ASME TECHNICAL DIGEST

Aviation

The Engineering Development of the Vickers' Vanguard. 58—A-273

By D. J. Lambert, Vickers-Armstrongs (Aircraft) Ltd., Weybridge Works, Weybridge, Surrey, England. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Design of the Vickers' Vanguard has proceeded from experience with short medium-haul turbine transports dating back to 1945 when the "Viscount" design was commenced. Experience obtained on the world's air routes and in maintenance hangars showed that broader operational requirements would have to be met by the Viscount replacement.

Project design and development of the Vanguard were governed by the following philosophy:

1 Optimum short-haul economics.

2 Range permitting an operator to use it as a middle-stage workhorse between the Viscount and a big jet.

3 Layout and design necessary for a high-density short hauler with the added attraction of potential fare reduction.

4 Fully up to date, but not unnecessarily sophisticated, replacement for the network of regional operators now flying Viscounts, DC-6's, and so on.

The Vanguard's aerodynamic characteristics include:

A modified NACA 63 wing section with a thickness chord ratio varying from 15 per cent at the root to 13 per cent at the tip.

Fowler type flaps are divided into four sections per side and all eight sections are actuated from a large hydraulic jack in the starboard inner plane driving a spanwise torsion shaft with cable operation of the guide rail trolleys.

All flying control surfaces are manually operated through large servo or spring tabs and aerodynamic balance is provided by set-back hinges on the elevators and rudder, and by Irving type shrouded balance on the ailerons.

Conical propeller spinners are fitted for high-intake efficiency.

Structural design philosophy has been one of low stress levels. Stress levels are calculated to ensure that the rate of propagation of cracks or ruptures is such that they will be found on normal inspection cycles.

The Vanguard power plant incorporates the Rolls-Royce Tyne propeller turbine engine fitted with a 14-ft-6-in-diam, four solid-bladed, De Havilland propeller.

The Tyne is the first of a group of two-shaft, high-compression-ratio, propeller turbines. The arrangement of the engine is such that the high-pressure compressor is driven by its own turbine and the low-pressure compressor and propeller are driven by a separate turbine, the shaft of which runs inside the high-pressure shaft. The propeller is coupled to the low-pressure shaft through a compound epicyclic reduction gear.

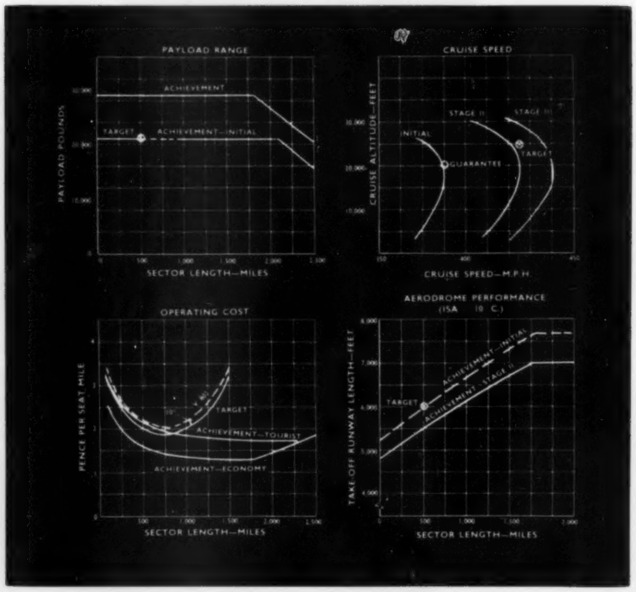
A Rotol accessory gearbox is mounted under each engine and is driven from the low-pressure section.

The main electrical system operates on 28 volts direct current. Power is supplied by six variable-frequency a-c alternators driven from the accessory gearboxes.

Four engine-driven constant displacement pumps, mounted one on each accessory gearbox, supply the hydraulic system at 3000 psi to operate the landing gear, flaps, wheel brakes, nose wheel steering, air steps, and propeller brakes.

Further details are given in this paper on the aerodynamic aspects, the structural design philosophy, structural testing, wing structure, fuselage, power-plant installation, undercarriage, electrical systems, the hydraulic system, air conditioning and pressurization, and the fuel system.

The Vickers' Vanguard short-medium haul turboprop—comparison of design targets and achievements (58—A-273)



Power

An Evaporator Vapor Purity Test Using the Sodium Tracer Technique ....58—A-237

By H. R. Lawrance and R. J. Ziobro, Griscom-Russell Company, Massillon, Ohio. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

A flame photometer with photomultiplier attachment was recently used to conduct vapor purity studies on a Griscom-Russell Bentube evaporator purchased by The Virginia Electric and Power Company for the Possum Point Station, unit no. 3. The evaporator was designed to produce 24,410 lb per hr of vapor containing less than 0.5 ppm dissolved solids, and a Thoroughfare venting system was used to minimize the concentration of CO_2 in the evaporator condenser effluent. The photometer flame box was modified by providing piping through which a continuous flow from the sample nozzle to the burner was established. Connections were furnished for the calibration standards and for water with low sodium content which was used in determining the flame background transmittance. A strip-chart recorder provided a permanent and continuous record of the sample sodium content.

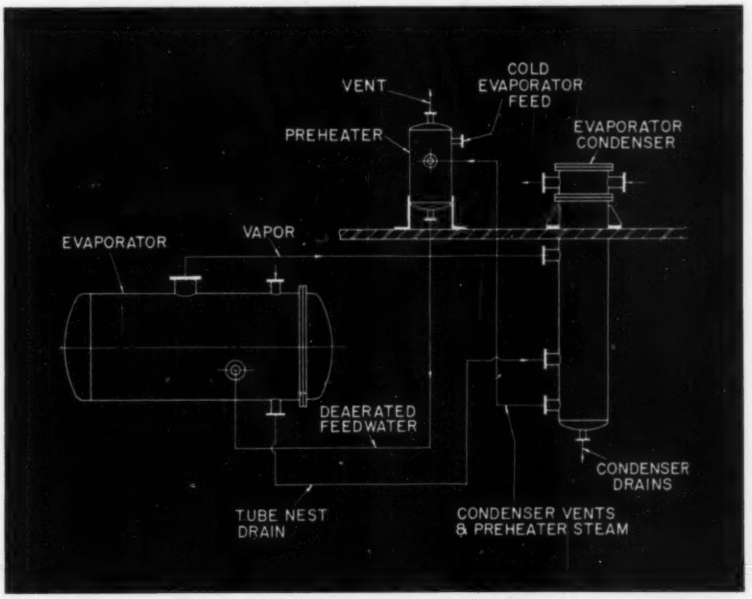
Portions of carefully prepared distillate standards were analyzed for sodium content by an independent laboratory using a Model DU spectrophotometer. Flame background readings were computed by averaging transmittance values at wave lengths each side of and equidistant from the sodium wave length.

A 1-in-OD stainless-steel sample tube having orifices 0.231-in. diam was installed in a vertical rising section of the vapor line. An alternate nozzle, $^5/_8$-in. OD with orifices 0.1875-in. diam, was located 24 in. downstream from and at right angles to the 1-in. nozzle. The cooling coil was considerably larger than necessary, and the cooling water flow was adjusted carefully until the sample temperature corresponded as closely as possible to the ambient-air temperature.

Results have shown that evaporator vapor may be produced containing less than 10 parts per billion total dissolved solids over a wide range of vapor flows.

It has also been shown that a maximum level increase of 5 in. (which is more than adequate for displacement-type controllers) will not adversely affect the vapor purity if the splash baffle has been located properly. The results also have shown that excellent purity may be obtained without the use of a moisture separator although a simple centrifugal separator provides great protection against severe carry-over during abnormal operation.

Schematic arrangement of Thoroughfare venting system used to minimize concentration of CO_2 in evaporator condenser (58—A-237)



A New Performance Criterion for Steam-Turbine Regenerative Cycles ....58—A-205

By J. Kenneth Salisbury, Fellow ASME, Atherton, Calif. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

A new concept of the regenerative cycle that utilizes a single variable as a criterion of the thermodynamic excellence of the feedwater-heating system for any given set of cycle boundary conditions is introduced. This variable is responsive to any change whatsoever that may occur within the heater system, and moreover quantitatively indicates the net effect on the heat rate. Since it is an over-all criterion, readily obtainable from relatively few data, it is believed that its applications are manifold in areas such as analysis of cycle designs, appraisal of the effect of changes, and monitoring of the performance of existing systems, for comparison with guarantees.

The variable, designated as H_e, is defined concisely as the flow-weighted enthalpy of extraction steam. It is, in effect, the "center of gravity" of the turbine extraction enthalpies. Its simplicity as a concept, and the ease with which it may be determined in an actual power plant, enhance its usefulness. It is probably true that those who have worked with regenerative cycles have worked around the concept many times, without identifying it or exploring its usefulness as a tool.

It is the primary purpose of this paper to present a clear, concise exposition of the H_e concept, rather than to develop all of the ramifications of its use. It is a secondary purpose to indicate a few of the quantitative relationships that have been developed in approaching the larger problem of complete performance monitoring.

Effect of Steam-Turbine Reheat on Speed-Governor Performance ....58—A-36

By Charles Concordia, Fellow ASME, General Electric Company, Schenectady, N. Y. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. of Engng. for Power;* available to Oct. 1, 1959).

The effect on the frequency, stability, and response of an electric power system of the use of steam-turbine reheat is shown in this paper. It is shown that in general, reheat tends to decrease the damping of the frequency variations of the system as a whole, to increase the damping of tie-line power oscillations, and to increase the maximum frequency deviation occasioned by an abrupt load change. The system responses were determined by means of an analog computer.

Stresses in Contoured Openings of Pressure Vessels.......58—A-207

By D. E. Hardenbergh, The Pennsylvania State University, University Park, Pa. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

In the fall of 1955 the Pressure Vessel Research Committee of the Welding Research Council conceived and put into action a research program aimed at producing experimental data and providing impetus toward more basic theoretical study on problems concerning stresses in reinforced and unreinforced openings in pressure vessels. This paper is a report on a part of this program and deals only with the problem of obtaining by experimental-stress-analysis methods the stresses in nozzles issuing from hard full-scale models of pressure vessels. All of the work described in this paper was performed at The Pennsylvania State University. The research was financed by the United States Atomic Energy Commission, and the work was performed with the technical assistance of The Pressure Vessel Research Committee.

The aim of this study is to provide experimental results which will accurately show the state of stress on both the outer and inner surfaces of different types of nozzles and branch connections of various shapes and sizes. The investigation will ultimately include the study of the effect on nozzle openings of most of the loading conditions encountered in engineering practice.

This is a report on experimentally determined stresses on both the outer and inner surfaces of two large cylindrical pressure vessels, in the immediate vicinity of the intersection of the main shell and welded cylindrical branch pipes. The vessels were loaded by internal pressure. Stresses were obtained by using rectangular strain rosettes made of A-18, SR-4 electrical resistance strain gages. The gage length of the A-18 gage is $^1/_8$-in. In addition, stresses were measured at a few points in the main shell of the vessel and in the branch pipes, at locations well removed from the branch connections.

Protection of Turbine Generators and Boilers by Automatic Tripping ....58—Pwr-8

By W. C. Beattie, Mem. ASME, H. A. Bauman, J. M. Driscoll, Mem. ASME, P. T. Onderdonk, Mem. ASME, and R. L. Webb, Consolidated Edison Company, New York, N. Y. 1958 ASME-AIEE Power Conference paper (multilithographed; to be published in Trans. ASME—*J. Engng. for Power;* available to July 1, 1959).

For over five years an integrated automatic trip protection system for unit turbine-generators and boilers has been in operation at the Astoria Station of the Consolidated Edison Company. The system, together with its major auxiliaries, is designed to protect equipment against damage from: Thrust bearing failure, excessive vibration, excessive exhaust hood and condenser shell temperature, loss of vacuum, excessive overspeed, failure of air supply for combustion, complete interruption of all fuel, and numerous other causes of damage.

The company now has had five years experience with three 200-mw units so protected. This paper relates the actual shutdown experienced as a result of the automatic trip system functioning. Troubles, design changes, and additions incorporated in the protection system on new units now being installed are also discussed.

Theoretical Stresses Near a Circular Opening in a Flat Plate, Reinforced With a Cylindrical Outlet...............................58—A-171

By E. O. Waters, Mem. ASME, Yale University, New Haven, Conn. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Engng. for Power;* available to Oct. 1, 1959).

Formulas are derived for stresses in the neighborhood of a circular hole in a flat plate, when the opening is reinforced with a cylindrical outlet such as a pipe or nozzle. The plate is loaded in tension, either uniformly in all directions, or with transverse and longitudinal tensions in the ratio of 2:1 as is the case in cylindrical pressure vessels. Consideration is given to the possibility of "balanced reinforcement" by adding material on both sides of the plate. Tables and graphs are included for the use of designers who wish to find the stress-concentration factors for different combinations of plate thickness, outlet-wall thickness, and outlet diameter.

Thermal and Economic Considerations in the Application of Hydraulic Couplings for Boiler Feed-Pump Drives................58—A-214

By T. J. Whelan, Mem. ASME, Stone and Webster Engineering Corporation, Boston, Mass. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

In evaluations to determine whether hydraulic couplings should be installed to provide variable-speed operation of boiler feed pumps, as compared to constant-speed operation, in steam-electric power stations, the power saving obtained with variable-speed operation is often considered to be a major factor in justifying the additional investment for hydraulic couplings.

It is the purpose of this paper to show that, when the effects of constant and variable speed operation on the feed-heating cycle are considered and the present-worth value of the difference in predicted annual fuel costs is taken into account, the net power saving with variable-speed operation contributes comparatively little, if anything, toward the justification of additional initial investment for hydraulic couplings. The justification of additional initial investment for hydraulic couplings, therefore, rests principally on the expectation that maintenance costs will be reduced and the life of equipment extended.

The Application of Computers to the Small Power Plant......58—A-230

By E. S. Monroe, Jr., Mem. ASME, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

There are many areas where automatic computers can be applied economically to the small power plant.

Programming costs for automatic computers can be minimized by avoiding complicated calculations that either do not increase the solution accuracy or that include nonsignificant factors.

Thinking in terms of computer programming can often lead to improved ways of performing existing tasks with simple calculating equipment.

This paper shows that the same criteria used to justify the application of an automatic computer to a large power station also apply to a smaller industrial station.

Applications in the fields of design, heat balances, cost accounting, power-generation standards, and power-consumption standards are analyzed. Particular emphasis is placed upon the actual preparation of a program for determining the heat-balance solution of a small steam, electric, and refrigeration station which can serve both as a continuous guide for daily operation or as a power-generation standard.

Generalized Steam Power Plant Heat Balance for Digital Computer Application...........58—A-213

By Alexander Zabludowsky, Stone and Webster Engineering Corporation, Boston, Mass. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

The great strides in the machinery and techniques of digital computation during the past decade have made the digital computer an important, sometimes indispensable, tool for the solution of engineering problems. Most advantageous for solution on a computer are highly

repetitive problems involving a large amount of computation. Many such problems are poorly defined in terms of a generalized solution procedure, which is the prime prerequisite for an efficient computer program. One such problem often encountered in engineering work is the steam-power-plant heat balance.

Steam-power-plant heat balances consist of determining the conditions at many points in the steam cycle from various turbine data and throttle conditions. From these results, the kilowatt output of the unit is determined. The complexity of the solution is found in the large variety of turbine cycles and the variety of components involved.

The basic conditions that have to be determined are flow, pressure, temperature, and enthalpy at various points in the cycle which is composed of a number of turbines, reheaters, condensers, pumps, air ejectors, gland-seal condensers, heaters, evaporators, steam air heaters, jet coolers, deaerators, attemperators, blowdown flash tanks, and valves. All these components may be interconnected in any number of ways resulting in an almost infinite number of cycle configurations.

Without entering upon the field of computer programming or the choice of a specific computer, a generalized method for solution of a power-plant heat balance is presented, showing its restrictions and limitation on one hand and its flexibility on the other.

A Combined Steam Gas-Turbine Cycle to Use Coal......58—A-174

By R. W. Foster-Pegg, Mem. ASME, ALCO Products, Inc., Schenectady, N. Y. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

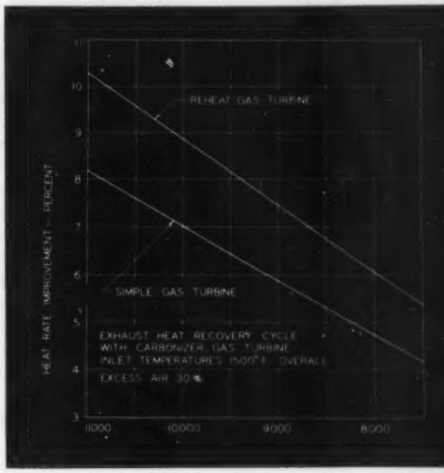
The combination of steam and gas turbines offers substantial reductions in heat rate, which are supplementary to improvements obtained from the steam cycle. Several plants of this type already are in operation or on order, but to date only clean fuels can be used in the gas turbine.

Combined power plants may use the supercharged boiler cycle, in which the gas side of the boiler is located between the compressor and gas turbine and is supercharged at compressor delivery pressure, or the exhaust-heat-recovery cycle in which the boiler operates at atmospheric pressure, and is located after the gas turbine.

Combined power plants will not be generally accepted until they can be operated economically on coal, which is by far the most abundant and, in most localities, the cheapest fuel.

The problems involved in the operation of combined steam-gas turbine power plants on coal are briefly discussed, followed by a description and cost estimate of a method which seems to have been overlooked previously. In this process, the volatile constituents of coal are continuously separated from char by carbonization. Gaseous products are burned in the gas turbine, and the char in the boiler of a combined power plant operating on the exhaust-heat-recovery cycle. Almost all of the thermodynamic improvement, normal for the exhaust-heat-recovery cycle when using clean fuel, can be anticipated when using coal by this method. No apparent major technical problem remains to be solved, and it is believed that capital cost should be no more than for a conventional plant.

Heat-rate improvement resulting from combination of a gas turbine with a steam power plant (58—A-174)



Metals Engineering

The Failure of Structural Metals Subjected to Strain-Cycling Conditions ....58—A-198

By R. W. Swindeman and D. A. Douglas, Oak Ridge National Laboratory, Oak Ridge, Tenn. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.;* available to Oct. 1, 1959).

Data showing the isothermal strain-cycling capacity of three metals, Inconel, Hastelloy B, and beryllium are presented. It is noted that at frequencies of 0.5 cycle per min the data satisfied an equation of the form $N^{\alpha}\epsilon_p = K$, where N is the number of cycles to failure, ϵ_p is the plastic strain per cycle, and α and K are constants whose values depend on the material and test conditions. Data on Inconel are given to establish the effect of grain size, specimen geometry, temperature, and frequency. It is found that, at temperatures above 1300 F, grain size and frequency exert a pronounced effect on the rupture life. Fine-grained metal survives more cycles before failure than coarse-grained material. Long time cycles shorten the number of cycles to failure when the strain per cycle is low. Thermal-strain-cycling data for Inconel are compared to strain-cycling data at the same mean temperature. Good correlation is found to exist between the two types of tests.

Thermal-Stress Ratchet Mechanism in Pressure Vessels....58—A-129

By D. R. Miller, Mem. ASME, General Electric Company, Schenectady, N. Y. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.;* available to Oct. 1, 1959).

The combination of cyclic thermal stresses and sustained internal pressure in a vessel is shown to be a source of progressive expansion of the vessel if the stresses are sufficiently high. Criteria presented allow determination of limits to be imposed on stresses in order to prevent progressive expansion or to allow estimation of the expansion per cycle where stresses are sufficient to produce growth. The effect of strain-hardening of the metal on progressive reduction of the growth rate is discussed.

Creep-Rupture Strength of Austenitic Cr-Ni-Mo Steels in Sheet and Bar Form.............58—A-102

By G. V. Smith, Cornell University, Ithaca, N. Y.; F. Garofalo, R. W. Whitmore, and R. R. Burt, U. S. Steel Corporation Research Center, Monroeville, Pa. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.;* available to Oct. 1, 1959).

Creep-rupture tests at 1100, 1300, and 1500 F on seven bar-stock and seven sheet-stock, 18 Cr-8 Ni-Mo steels show that small variations in C, N, and P measurably influence both 100 and 1000-hr creep-rupture strength. Variation in amounts of C, N, and P accounts for at least one third of the variability in creep-rupture strength. The additional variability may be related to differences in thermal and mechanical history, and in the inherent variability in creep-rupture testing. The bar-stock steels are slightly stronger at 1100, 1300, and 1500 F for

rupture in 100 hr and at 1300 and 1500 F for rupture in 1000 hr. At 1100 F, essentially no difference is found between bar and sheet steels for the 1000-hr rupture strength.

A General Approach to the Practical Solution of Creep Problems.... ....58—A-98

By A. Mendelson, M. H. Hirschberg, and S. S. Manson, National Aeronautics and Space Administration, Cleveland, Ohio. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.;* available to Oct. 1, 1959).

The present trend in stress analysis is to take into account in a more rigorous fashion the complex phenomena of plastic flow and creep. This is due to the many more high-temperature applications and the necessity of designing for maximum stress in order to reduce component weight. Furthermore, the widespread availability of high-speed computing machinery makes such computations more feasible. However, although there exists a great deal of literature on the subject of plastic flow and creep, very little has been done in presenting simple numerical methods for solving specific problems of engineering interest and, in most cases where such methods have been presented, restrictive assumptions were made to obtain the solutions.

A general method is presented for the solution of creep problems by the use of successive approximations. The method is equally applicable to different creep laws and loading paths. Examples are presented for the creep in a flat plate with a temperature gradient and for several cases of rotating disks. In these disk problems the transient conditions prior to the establishment of steady-state stress distribution are included and shown to have an appreciable effect on the total creep strains. The use of different cumulative creep laws such as the time-hardening and strain-hardening laws are illustrated.

Irradiation of Haynes-25 and Inconel-X Compression Springs in High-Temperature High-Pressure Water..................58—A-94

By R. L. Mehan, General Electric Company, Schenectady, N. Y. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.;* available to Oct. 1, 1959).

It is known from past experimental work that metals subjected to neutron bombardment undergo changes in mechanical properties. In general, strength properties increase and ductility decreases. These effects tend to increase with increasing neutron exposure. Because of this radiation-damage effect, materials chosen for use in nuclear reactor cores where neutron exposures are appreciable must be scrutinized carefully for possible harmful changes in properties resulting from this exposure. When the exposure takes place in a corrosive environment such as high-temperature high-pressure water, corrosion effects must also be considered.

Irradiation tests were performed on Haynes Stellite Alloy 25 and Inconel-X springs irradiated in the compressed condition in an in-pile high-temperature water loop. The loop was operated at 560 to 600 F and the springs of both materials received integrated fluxes of 5.9×10^{18} and 4.2×10^{19} *nvt* fast, respectively. Postirradiation testing and examination revealed no serious deleterious effects resulting from these exposures. It was found the spring constant increased 5 to 8 per cent after exposure and the free length decreased 2 to 3 per cent. The effect of irradiation on the plastic-flow curve was slight as revealed by three-point loaded bend tests on 0.160-in-diam rods irradiated with the springs.

Refractory Metal Facings for Protection of Metal Surfaces Subjected to Repeated High-Temperature Pulses ....58—A-188

By Aaron Cohen, Convair Astronautics, San Diego, Calif.; and Edward Homer, Radio Corporation of America, Harrison, N. J. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.;* available to Oct. 1, 1959).

Because the operating frequency of a magnetron has a direct relationship to the size of the resonant structure, the power at a given frequency that can be obtained from a magnetron may be limited by the temperature which the resonating structure can withstand. A rise in the temperature of the resonant structure is caused by the impact of high-energy electrons emitted from the cathode at high peak-power levels for short durations.

This paper deals with the analytical determination of the temperature of the resonant structure, a solution to the heat problem in which a thin coating of refractory metal is used to prevent the vulnerable components from melting, and some experimental results to verify the analysis.

Production Engineering

High-Range Plasticity of Metals Beyond Normal Work-Hardening.. ....58—A-132

By E. V. Crane, Mem. ASME, and W. S. Wagner, E. W. Bliss Company, Canton, Ohio. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Engng. for Indus.;* available to Oct. 1, 1959).

Metals, plastically worked for mass-production purposes, are shown to have a little known and potentially valuable "high" working range, primarily compressive and substantially beyond commonplace practices and physicals. This "high range" lies beyond the point of normal tensile failure. It is distinguished by a steeper or more rapid rate of work-hardening. While some use has been made of it, to advantages, in wire-drawing, rolling, cold extrusion, and shell drawing, inadequate technical data concerning it may be attributed to unfamiliarity with the testing program.

To provide pressed-metal engineering with the extended plastic-range data needed for planning operation sequences, a testing technique is outlined which, if not new, is at least unfamiliar and potentially useful until a better method is devised.

Vibrations of Flexible Precision Grinding Spindles.......58—A-97

By R. S. Hahn, Mem. ASME, The Heald Machine Company, Worcester, Mass. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Engng. for Indus.;* available to Oct. 1, 1959).

Grinding chatter has plagued precision-grinding operations for many years. In general, these vibrations between the grinding wheel and workpiece have a detrimental effect. Not only do they leave the workpiece with an untrue surface but they also may cause a reduced grinding rate.

The analysis presented here, although derived with flexible internal grinding spindles in mind, may be applied also to other flexible grinding spindles, and the section on the forced vibrations of shafts with skew-symmetric rigidities is applicable to shafts supported by three or more bearings, one of which is misaligned with respect to the remainder, thereby setting up radial loads.

The objective of the work to follow is to determine the stability characteristics of the system composed of the grinding spindle and wheel and the workpiece, i.e., to determine whether small transient

vibrations, which may be randomly impressed on the system, tend to grow and increase in magnitude as grinding proceeds or whether they are damped out and disappear.

Observations on the Angle Relationships in Metal Cutting........ ....58—A-138

By D. M. Eggleston, R. Herzog, and E. G. Thomsen, Mem. ASME, University of California, Berkeley, Calif. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Engng. for Indus.;* available to Oct. 1, 1959).

Orthogonal-cutting experiments using SAE 1112 free-cutting steel, 2024-T4 and 6061-T6 aluminum alloys, and alpha-brass (85 Cu-15 Zn) at feeds of 0.002 to 0.010 ipr, were performed on a lathe with 18-4-1 high-speed-steel cutting tools. The mean-cutting speeds and rake angles for SAE 1112 varied from 33.7 to 170.8 fpm and 5 to 40 deg, respectively, while the remainder of the alloys were tested at conditions yielding a continuous chip without a built-up edge at speeds ranging from approximately 470 to 790 fpm. It was found that the angle λ between the shear plane and the resultant tool force R was only approximately constant for each test condition and varied with cutting speed. Hence the equation $\lambda = \phi + \beta - \alpha =$ const and the linear relationship between ϕ and $\beta - \alpha$ are only approximately satisfied. Furthermore, neither the Ernst and Merchant minimum-energy criterion, nor the Lee and Shaffer, nor the Hill ideal plastic-solid solution, are in agreement with all the experimental observations.

Approximate Solutions to a Problem of Press Forging...58—A-140

By S. Kobayashi, Doshisha University, Kyoto, Japan; and E. G. Thomsen, Mem. ASME, University of California, Berkeley, Calif. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Engng. for Indus.;* available to Oct. 1, 1959).

The velocity vectors in the flash and body of a press forging of commercially pure lead having axial symmetry were obtained experimentally from incremental displacements in stepwise forging operations. It was found that the velocities are in excellent agreement with those derived with the aid of a simple disk theory, where it was assumed that all deformation is concentrated in a fictitious disk. Comparison with velocities derived from certain slip-line solutions also shows that substantial agreement exists here between theory and experiment.

Calculated average forging pressures, which were obtained by the approximate disk and slip-line theories, are in approximate agreement and the local pressure distributions are similar. These results seem to clarify the role which the flash height and friction in the die-lands play in achieving a good impression of the die cavities.

Abrasive Finishing of Hard Gears ....58—A-226

By H. Pelphrey, Michigan Tool Company, Detroit, Mich. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

By using an abrasive gearlike tool, material can be removed from the flanks of gear teeth without the necessity of the two being otherwise geared together. The tool and work are not presented to each other with their axes in the same plane but are crossed in the same manner as used in the well-known process of gear shaving. The purpose of this process, as may be gathered, is to improve gear-tooth action at a low cost. This improvement can be realized by one or more of the following: (*a*) Remove burrs and projections thrown up around nicks; (*b*) improve surface finish; (*c*) lead; and (*d*) profile.

Hydraulics

Free Discharge Through a Turbine Distributor, Case, and Draft Tube.. ....58—A-76

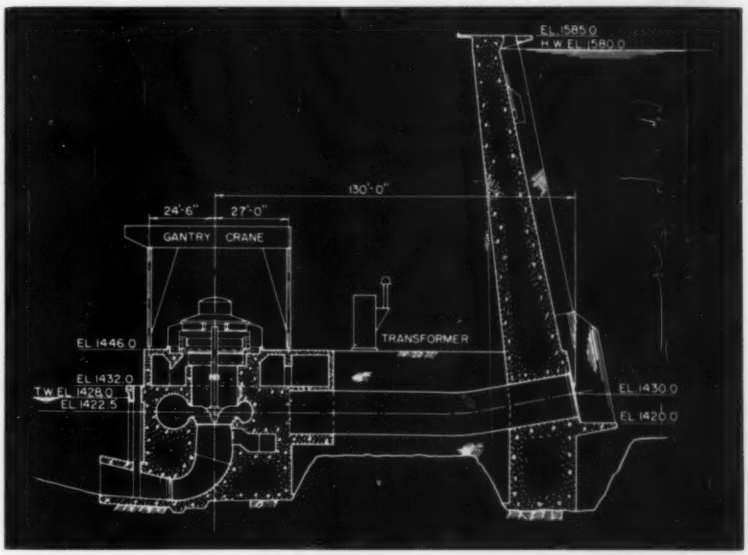
By R. A. Sutherland, Mem. ASME, Ebasco Services Inc., New York, N. Y. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.;* available to Oct. 1, 1959).

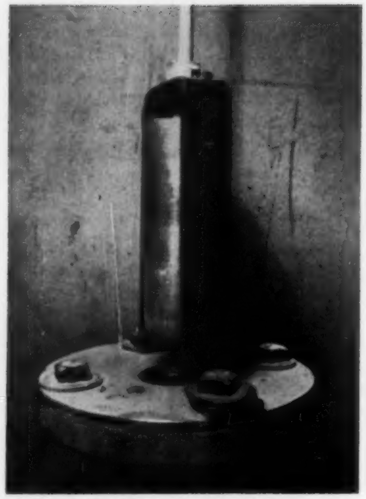
The Pelton Hydro-Electric Development of the Portland General Electric Company is located on the Deschutes River in north central Oregon and comprises a thin arch dam 204 ft high, with spillway and appurtenant structures, and a powerhouse containing three units each of 32,400-kw name-plate capacity operating under a head of 152 ft. The turbines are rated at 150 ft net head, 52,200 hp at 138.5 rpm corresponding to a discharge of 3470 cfs on the guaranteed efficiency basis. The penstocks are 16 ft in diameter and that of No. 2 unit is approximately 130 ft long to center line of unit.

Approximately three miles downstream from the dam is a re-regulating dam which serves the purpose of smoothing out the nonuniform discharge from the powerhouse. A fish ladder extends from a point below the re-regulating dam to the main storage reservoir. The first unit commenced commercial operation on Dec. 20, 1957, and the discharge through unit No. 2, as described in this paper, took place during the period from Nov. 29, 1957, to Jan. 2, 1958.

The experience of discharging water freely through the turbine without the runner at the development is described and an indication of the discharge coefficient is given.

The Pelton Hydro-Electric Development on the Deschutes River, Ore. (58—A-76)





Plunger valve for assimilating constant hydraulic-power condition (58—A-29)

Large Water-Level Displacements in the Simple Surge Tank. 58—A-29

By A. W. Marris, Assoc. Mem. ASME, University of British Columbia, Vancouver, B. C., Canada. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.;* available to Oct. 1, 1959).

The nondimensional unapproximated form of the equation describing the motion of the water level in a simple nonthrottled open surge tank operating under the condition of constant hydraulic power to the turbine is shown to have two singular points. One of these is at the steady-flow hydraulic grade-line level and accounts for small displacement phenomena. The other is at a lower elevation and accounts for the occurrence of drainage due to insufficient power being available at the turbine.

Symposium on Welded Spiral Cases From the Manufacturer's Viewpoint ....58—A-60

A Five-Part Symposium. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.;* available to Oct. 1, 1959).

An important but unspectacular part of hydroelectric power developments is the steel spiral case that guides the water from the penstock into the hydraulic turbine. The increasing acceptance of welding and the use of high-strength steels in the construction of spiral cases have permitted and required the development of new construction methods. This report is a condensation of the five prepared statements by representatives of the U. S. and Canadian manufacturers presented at the 1957 ASME Annual Meeting.

After an "Introductory Statement," by J. Fisch, Mem. ASME, S. Morgan Smith Company, York, Pa., the following subjects were covered by the symposium:

"History of Field-Welded Spiral Cases," by W. J. Rheingans, Mem. ASME, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

"Fabrication and Assembly of Spiral Cases Designed for Field Welding," by W. N. Woodall, Newport News Shipbuilding & Drydock Company, Newport News, Va.

"Field Assembly and Welding of Spiral Cases," by C. A. McDonald, Mem. ASME, Horton Steel Works, Ltd., Fort Erie, Ont., Canada; and P. C. Arnold, Chicago Bridge & Iron Company, Chicago, Ill.

"Spiral Cases Weld-Fabricated of High-Strength Steel," by J. Fisch.

"A Turbine Designer's Viewpoint on Spiral Cases," by L. P. Litzinger, Jr., Baldwin-Lima-Hamilton Corporation, Philadelphia, Pa.

Optimum Design of Straight-Walled Diffusers..............58—A-137

By S. J. Kline, Mem. ASME, D. E. Abbott, and R. W. Fox, Stanford University, Stanford, Calif. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.;* available to Oct. 1, 1959).

The four common optimum problems in diffuser design are defined. These optima are located in relation to the over-all flow regimes in terms of geometrical parameters for straight-walled units. Using an empirically derived transformation of variables between the conical and two-dimensional geometries, all available data for optimum recovery at constant ratio of wall length to throat width are correlated by a single straight line. This line lies slightly above and parallel to the line of onset of large transitory stall on the chart of over-all flow regimes. The correlated results are based on a literature survey. The range of conditions for each investigation is tabulated for convenient future reference

Applied Mechanics

The Wedge Under a Concentrated Couple: A Paradox in the Two-Dimensional Theory of Elasticity.. ....58—A-15

By Eli Sternberg, Mem. ASME, Brown University, Providence, R. I.; and W. T. Koiter, Technische Hogeschool, Delft, Holland. 1958 ASME Annual Meeting paper (in type; published in Trans. ASME—*J. Appl. Mech.,* December, 1958; available to Oct. 1, 1959).

The classical two-dimensional solution for the stress distribution in an elastic wedge which is subjected to a concentrated couple at the vertex, breaks down when the opening angle 2α of the wedge satisfies the equation tan $2\alpha = 2\alpha$, i.e., when 2α is approximately 257 deg. As the foregoing critical opening angle $2\alpha_*$ is approached, all of the nonvanishing components of stress become infinite throughout the field, while the solution displays no obvious pathological characteristics for other values of the wedge angle. It is the purpose of the present paper to account for this peculiar singular behavior and to show that the solution under examination has physical significance only for wedge angles below the critical angle; for opening angles in the range $2\alpha_* \leq 2\alpha < 2\pi$, the notion of a "concentrated couple" at the vertex of an elastic wedge, is found to be inherently deficient in meaning. The present investigation, as a by-product, augments the supply of counterexamples to the traditional version of Saint Venant's principle.

Transient Film Condensation...... ....58—A-13

By E. M. Sparrow, Assoc. Mem. ASME, and R. Siegel, Assoc. Mem. ASME, National Aeronautics and Space Administration, Lewis Flight Propulsion Laboratory, Cleveland, Ohio. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

An analytical solution for transient laminar film condensation on a vertical plate is obtained using the method of characteristics. The situation considered is one in which the plate temperature, initially the same as that of the saturated vapor, is suddenly dropped. Results are obtained for transient heat-transfer coefficients and for the time required to achieve steady state.

Elastic, Plastic Stresses in Free Plate With Periodically Varying Surface Temperature...........58—A-16

By Halil Yüksel, Brown University, Providence, R. I. 1958 ASME Annual Meeting paper (in type; published in Trans. ASME—*J. Appl. Mech.,* December, 1958; available to Oct. 1, 1959).

The analysis of thermal stresses in solids is usually based on the assumption of perfectly elastic behavior. While

this assumption seems entirely unrealistic for the extreme thermal conditions to which modern flight structures and ordnance components may be exposed, the analysis of thermal stresses in inelastic solids is still a comparatively unexplored field. The present paper is concerned with the thermal stresses in a free plate when the temperature of one face varies harmonically with time, while that of the opposite face is constant and the edge is perfectly insulated. These thermal boundary conditions represent an obvious idealization of the conditions encountered in many applications, where the plate separates a region with closely controlled temperature from a region with fluctuating temperature. Aside from the practical importance of the problem treated here, any increase of the small stock of the worked-out examples is bound to prove useful in the exploration of field of nonlinear mechanics of solids.

Axially Symmetric Buckling of Shallow Spherical Shells Under External Pressure.......58—A-14

By E. L. Reiss, New York University, New York, N. Y. 1958 ASME Annual Meeting paper (in type; published in Trans. ASME—*J. Appl. Mech.*, December, 1958; available to Oct. 1, 1959).

A formula for the initial buckling loads for clamped, shallow spherical shells under uniform external pressure is obtained by combining the solutions of two linearized versions of the original nonlinear problem. One of these versions is a linear eigenvalue problem, while the other is the bending problem for a shallow cap in the linear theory of elasticity. The formula, which is obtained in a simple manner, yields buckling loads that are in better agreement with experiments than previous approximate solutions to the nonlinear problem.

Retarded Flow of Bingham Materials.................58—A-34

By Alfred Slibar, Technische Hochschule Stuttgart, Stuttgart, Germany; and P. R. Paslay, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

Solutions for three cases of retarded flow of a rigid-viscous material are given. These cases are: (*a*) Sliding parallel plates; (*b*) Couette flow between concentric cylinders; and (*c*) axial flow through a circular pipe. For Couette flow two types of loading-unloading paths are found. The results of this analysis explain some of the discrepancies between experimental results and theoretical predictions for a Bingham material.

Limit Analysis of Symmetrically Loaded Thin Shells of Revolution.. ....58—A-26

By D. C. Drucker and R. T. Shield, Brown University, Providence, R. I. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

The yield surface for a thin cylindrical shell is shown to be a very good approximation to the yield surface for any symmetrically loaded thin shell of revolution. Hexagonal prism approximations to this yield surface, appropriate for pressure vessel analysis, are described and discussed in terms of limit analysis. Procedures suitable for finding upper and lower bounds on the limit pressure for the complete vessel are developed and evaluated. They are applied for illustration to a portion of a toroidal zone or knuckle held rigidly at the two bounding planes. The combined end force and moment which can be carried by an unflanged cylinder also is discussed.

Velocity and Temperature Fluctuation Measurements in a Turbulent Boundary Layer Downstream of a Stepwise Discontinuity in Wall Temperature...........58—A-81

By D. S. Johnson, Bell Telephone Laboratories, Inc., Whippany, N. J. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

Results are presented of an experimental investigation of the coexisting thermal and velocity fluctuation fields in a turbulent boundary layer downstream of a small stepwise discontinuity in wall temperature. The statistical behaviors of several relevant fluctuating quantities have been obtained at a typical cross section of the boundary layer in the region where the thermal boundary layer has not yet reached the free stream. The instantaneous surface of demarcation between heated and unheated fluid was found to be sharp and distinct at all points, resulting in intermittent temperature fluctuation signals well within the fully turbulent region of the momentum boundary layer. From the measurements at one section, the balances of turbulent kinetic energy and of turbulent temperature fluctuations across the boundary layer have been evaluated. In addition, the distribution of the local turbulent Prandtl number (ratio of the turbulent diffusivities of momentum and heat) through the boundary layer has been obtained; it is not constant and varies between limits of 0.8 and 1.2.

The Synthesis of a Four-Bar Mechanism for Prescribed Extreme Values of the Angular Velocity of the Driven Link..........58—A-2

By J. Hirschhorn, New South Wales University of Technology, Sydney, N. S. W., Australia. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

The "component method" of synthesis of four-bar mechanisms was discussed in detail in a previous publication (see *Journal of Applied Mechanics*, vol. 24, Trans. ASME, vol. 79, 1957, pp. 22–24). The present paper shows the application of this method to the synthesis of four-bar linkages with prescribed extremes of the angular velocity of the driven or output link.

Frequencies of a Flexible Circular Plate Attached to the Surface of a Light Elastic Half-Space..58—A-37

By G. N. Bycroft, Department of Scientific and Industrial Research, Lower Hutt, New Zealand. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

The frequencies of free vibration of a thin, flexible, circular plate stuck to the surface of a massless elastic half-space are solved by an application of the Rayleigh-Ritz principle. The approximate fundamental frequency is considered in detail when the plate is clamped, free, or hinged at its periphery. The method of obtaining the higher frequencies, such as those involving nodal diameters, is indicated.

Root-Locus Analysis of Structural Coupling in Control Systems...... ....58—A-65

By R. H. Cannon, Jr., Massachusetts Institute of Technology, Cambridge, Mass. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

When a feedback system is devised to control a mechanical member that is structurally limber, unstable ("self-excited") vibrations may be encountered at approximately a natural frequency of the structural member. Cures are generally easy to effect once the phenomena are understood. Two interesting cases are described: ground vibrations of an airplane control system due to a limber fuselage, and vibrations of a stable platform system due to limberness in the platform structure. The investigations are carried out using the root-locus technique, which provides a plot of system characteristics as explicit functions of control strength. In the case of the stable platform, the analysis is found to be more reliable than physical intuition.

Some Preliminary Results of Visual Studies of the Flow Model of the Wall Layers of the Turbulent Boundary Layer........58—A-64

By S. J. Kline, Mem. ASME, and P. W. Runstadler, Stanford University, Stanford, Calif. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

Preliminary studies of the flow model in the wall layers of the turbulent boundary layer are presented. Results are summarized for investigations of positive pressure gradients, zero and negative pressure gradients, readjusting zones, and the later stages of transition. In all cases, the special visual methods developed for these studies show a definite three-dimensional vortex-flow model. The presently available details of this model are described, a possible interpretation of the physics of the turbulent boundary layer is given, and some of the many implications of the flow model are discussed.

A Simple Approach to an Approximate Two-Dimensional Cascade Theory................58—A-23

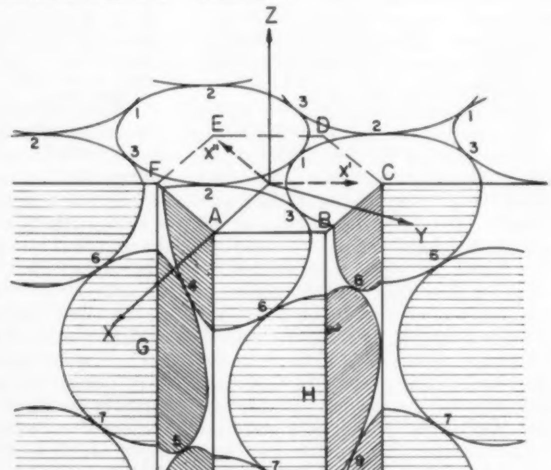
By M. J. Schilhansl, Brown University, Providence, R. I. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

In the paper a simple approach to an approximate theory of incompressible two-dimensional flow past cascades is based on the so-called singularity method, in which the blade sections are replaced by sheets of vortexes, sources and sinks, and the flow induced by these singularities is calculated. The condition that the flow must be tangential to the blade surface, sometimes termed as the tangency condition, leads to a relation between the geometrical shape of the blade sections (camber and thickness), the cascade parameters (solidity and stagger angle), and the singularity distributions along the mean camber lines. As soon as these distributions are known, the pressure distribution and the lift may be determined. The calculation of the velocities at the blades is the most laborious portion of the whole problem. It has been carried out by various authors with different mathematical methods. In this paper, a short, simple method of calculating the velocities induced by the singularities will be described. This approach has already been applied by others in less elaborate form.

Transients in Simple Undamped Oscillators Under Inertial Disturbances..............58—A-58

By Antongiulio Dornig, Polytechnic of Milan, Milan, Italy. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

Single-degree-of-freedom systems acted upon inertial forces are often found in technical applications. In this paper we shall study the transients in the vibrations of the system due to a change in speed in the machine in which the inertial forces are generated. We shall state the problem in the most general case, and then study the starting and the stopping with constant acceleration. After giving the exact solution of the problem we shall derive very simple approximate formulas for the determination of the maximum amplitude reached in these transients.



Hexagonal close-packed medium. Section shown is perpendicular to *z*-axis and lies between parallel planes. Numbers identify contacts. (58—A-53)

Postbuckling Behavior of Rectangular Plates With Small Initial Curvature Loaded in Edge Compression.. ....58—A-59

By Noboru Yamaki, Tohoku University, Sendai, Japan. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

The solution of Marguerre's fundamental equations for large deflections of thin plates with slight initial curvature is presented for the case of a rectangular plate subjected to edge compression. The problem is solved under eight different boundary conditions, combining two kinds of loading conditions and four kinds of supporting conditions. Numerical solutions are obtained for square plates with and without initial deflection, and the connections of deflection, edge shortening, and effective width of the plate with applied loads are clarified. The solutions here obtained include as special cases those investigated by Levy and Coan.

A Reassessment of Deformation Theories of Plasticity....58—A-54

By Bernard Budiansky, Harvard University, Cambridge, Mass. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

It is shown that deformation theories of plasticity may be used for a range of loading paths other than proportional loading without violation of general requirements for the physical soundness of a plasticity theory. The extent to which deviations from proportional loading are admissible on this basis is calculated quantitatively for the simple deformation theory of Nadai. It is shown that the lower the strain-hardening rate of the uniaxial stress-strain curve, the greater are the permissible deviations from proportional loading.

A Differential Stress-Strain Relation for the Hexagonal Close-Packed Array of Elastic Spheres..58—A-53

By J. Duffy, Assoc. Mem. ASME, Brown University, Providence, R. I. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

A differential stress-strain relation is derived for a medium composed of a hexagonal close-packed array of elastic spheres in contact. The stress-strain relation is based on the theory of elastic bodies contact, and includes the effects of both in normal and tangential components of contact forces. Results of an experiment performed as a test of the differential stress-strain relation are presented.

The Nonlinear Bending of Thin Rods .... 58—A-50

By T. P. Mitchell, Cornell University, Ithaca, N. Y. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

Nonlinear bending of straight and circular-arc cantilevers under vertical and horizontal point loads is analyzed from a unified approach. Formulas for determining the deflected shape of the cantilevers are presented. Closed-form solutions are obtained for bending under two types of distributed loads. In particular, the problem of bending under a uniformly distributed normal load is solved.

Analysis of Complex Kinematic Chains With Influence Coefficients .... 58—A-74

By J. Modrey, Assoc. Mem. ASME, Union College, Schenectady, N. Y. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

Highly complex kinematic chains can be analyzed by the use of simple vector equations involving influence coefficients. The influence-coefficient equations are related to superposition of simple kinematic chains. The technique for determining the necessary influence coefficients is one of sequentially setting all variables but one to zero and relaxing appropriate constraints to maintain mobility. This "zero-relax" process creates a series of mechanisms each simple enough to be solved by a direct process rather than by simultaneous equations. The analysis of the velocities and accelerations for these simpler mechanisms yields the influence coefficients of the related but more highly complex mechanism.

Collapse Loads of Rings and Flanges Under Uniform Twisting Moment and Radial Force........ .... 58—A-55

By Burton Paul, Assoc. Mem. ASME, Brown University, Providence, R. I. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

Limit loads are found for rigid-plastic rings of arbitrary cross section subjected to uniform twisting moments and radial forces distributed over the circumference. It is shown that the interaction curves for limiting values of twisting moment and radial force have the same shape as interaction curves for limiting bending and stretching of straight beams. For rings of small uniform thickness the collapse loads are found to agree very well with those predicted by thin-plate theory. The theory is applied to find the collapse load of thin-walled corrugated tubes under axial thrust.

On the Natural Modes and Their Stability in Nonlinear Two-Degree-of Freedom Systems..... 58—A-57

By R. M. Rosenberg and C. P. Atkinson, University of California, Berkeley, Calif. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

The natural modes of free vibrations of a symmetrical two-degree-of-freedom system are analyzed theoretically and experimentally. This system has two natural modes, one in-phase and the other out-of-phase. In contradistinction to the comparable single-degree-of-freedom system where the free vibrations are always orbitally stable, the natural modes of the symmetrical two-degree-of-freedom system are frequently unstable. The stability properties depend on two parameters and are easily deduced from a stability chart. For sufficiently small amplitudes both modes are, in general, stable. When the coupling spring is linear, both modes are always stable at all amplitudes. For other conditions, either mode may become unstable at certain amplitudes. In particular, if there is a single value of frequency and amplitude at which the system can vibrate in either mode, the out-of-phase mode experiences a change of stability. The experimental investigation has generally confirmed the theoretical predictions.

Unsteady Laminar Boundary Layers Over an Arbitrary Cylinder With Heat Transfer in an Incompressible Flow.................. 58—A-49

By Kwang-Tzu Yang, Assoc. Mem. ASME, University of Notre Dame, Notre Dame, Ind. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

A method is presented for calculating the development of momentum and thermal laminar boundary layers on a heated cylinder of arbitrary shape when the cylinder moves in an incompressible fluid at rest with an unsteady velocity. This analysis is based on solutions to the unsteady momentum and energy-integral equations in conjunction with a set of universal functions, derived from exact solutions to the boundary-layer equations for a specific unsteady problem. These universal functions are given in tabulated form. Those associated with the energy-integral equation are calculated with a Prandtl number of 0.7. The reliability and limitation of these functions are indicated and discussed in the light of several simple problems of which solutions are available. A detailed calculation procedure for the general unsteady problem is given, and then followed by a numerical example.

Analysis of a Compression Test of a Model of a Granular Medium.... .... 58—A-48

By C. W. Thurston and H. Deresiewicz, Assoc. Mem. ASME, Columbia University, New York, N. Y. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

A granular medium is idealized here by a model composed of contiguouslike spheres arranged in a face-centered cubic lattice. Total stress-strain relations for this model are derived by integrating incremental relations, given previously by Duffy and Mindlin, for a loading program which consists of a uniaxial compression applied concurrently with a related isotropic pressure. Further, the failure stress in uniaxial compression is determined as a function of initial pressure. Results of experimental work are reported which agree with predictions of the theory.

An Experiment on Compressible Flow Perturbations...... 58—A-52

By T. A. D'Ews Thomson, University of Sydney, Sydney, N.S.W., Australia; and R. E. Meyer, Brown University, Providence, R. I. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

The effect which a slight tilting of the liners of a supersonic wind-tunnel nozzle has on the Mach-number distribution in the test-rhombus is determined on the basis of the linear-perturbation theory. Experiments are reported which (*a*) confirm that the first-order subsonic and transonic perturbations of the flow may be neglected compared with the supersonic perturbations, and (*b*) indicate that appreciable effects not accounted for by the first-order theory occur when the flow possesses high local pressure gradients.

On Journal Bearings of Finite Length With Variable Viscosity..... .... 58—A-75

By L. N. Tao, Assoc. Mem. ASME, Illinois Institute of Technology, Chicago, Ill. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

An exact solution of the Reynolds equation for journal bearings of finite length with viscosity as a function of pressure is found. The analytical solution is expressed in terms of Heun functions. The load capacity and the attitude angle are derived. It is found that the load vector, in general, is not perpendicular to the line of journal and bearing centers as shown in the constant-viscosity case.

Fuels

Coal Cleaning in Relation to Sulfur Reduction in Steam Coals......... ....58—A-147

By H. J. Rose, Mem. ASME, and R. A. Glenn, Bituminous Coal Research Institute, Pittsburgh, Pa. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

At present, about 60 per cent of bituminous coal used in the United States is mechanically cleaned. The percentage cleaned has increased each year for the past 30 years, with few exceptions. There are more than 600 mechanical coal-cleaning plants in the United States. Steam coal is cleaned primarily to remove extraneous impurities resulting from the mechanized mining and loading methods which are used to reduce mining costs.

Current coal research expenditures in the United States for coal preparation amount to more than $600,000 annually. Most of this is for coal-cleaning projects. Because of the chemical and physical forms in which sulfur occurs in coal, only a small portion of the total sulfur can be removed by any known coal-cleaning process. The proportion which can be removed varies considerably with different coal beds and localities, but the proportion removed is seldom large.

The maximum removal of sulfur from coal by any known cleaning process does not even approach the possible removal of sulfur dioxide from the stack gases after the coal is burned. In other words, the sulfur is far more accessible for removal in stack gases than it is in coal.

The text of this paper contains data in the form of tables, graphs, and discussion to support the conclusion that only a small to moderate proportion of the total sulfur in coal can be removed by any known coal-cleaning process.

A description is given of the forms of sulfur in coal, their modes of occurrence, and the amounts of each form that are present in typical coals from several states.

Organic sulfur, which amounts to 20 to 60 per cent of the total, is structurally combined with the coal molecules and cannot be removed by any mechanical cleaning process. Pyritic sulfur makes up most of the remainder, or 40 to 80 per cent of the total sulfur. Pyritic sulfur that is finely disseminated or an integral part of coal pieces is not appreciably removed by coal cleaning. Pyritic sulfur that is segregated or "free," or that occurs in fairly high concentration in coal pieces, can be removed quite effectively.

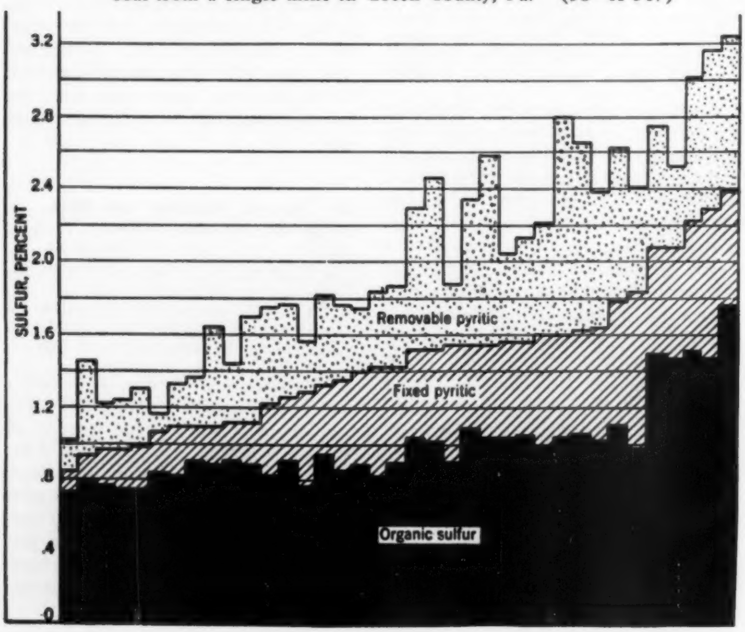
The "washability" of coals is determined by laboratory float-and-sink tests supplemented by tests in pilot-scale or full-scale preparation equipment. Washability characteristics of each coal and each size of coal must be systematically studied to permit a cleaning plant to be designed for that particular coal.

The paper discusses briefly the ash-forming constituents in coal, their modes of occurrence, and the factors which affect the removal or retention of such constituents during cleaning. Steam coal is cleaned primarily to remove extraneous mineral impurities.

The modes of occurrence of moisture in coal are also discussed briefly. Moisture has both advantages and disadvantages in steam coal handling and use. The moisture content should be controlled within limits which are appropriate for the various conditions. There are about 200 coal-drying plants in the United States.

Scientific knowledge that is presently available on coal cleaning does not hold definite promise for new and economical processes for further reducing the sulfur content of coal. However, there should be active research to develop fundamental information and possible new approaches to the problem of coal beneficiation.

Variations in total sulfur, sulfur forms, and removable pyrite at $^3/_8$-in. by 48 mesh, of face samples of Pittsburgh bed coal from a single mine in Green County, Pa. (58—A-147)



Need for and Requirements of Flame-Protection Equipment for Gas—Oil—Pulverized Coal....... ....58—A-227

By J. B. Smith, Factory Mutual Engineering Division, Norwood, Mass. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Larger boilers and correspondingly more severe boiler-furnace fuel explosions, manual lighting-off by remote control, and automatic lighting-off are three current trends in larger boiler installations, such as the public-utility type, which increase need for flame-failure protection equipment. Two criteria for direct and continuous measurement of the fuel-explosion hazard, utilizing instruments available today, are: (*a*) pressure or absence of normal flames and (*b*) concentration of combustibles and oxygen in the boiler-furnace flue gas.

The ability of the presently available instruments to furnish the protection needed and some of the special problems common to large boilers of the public-utility type are discussed.

It is concluded that flame-failure protection consisting of a combination of the flame-sensing and combustibles-oxygen gas-analyzer instruments should be recommended for such boilers.

Compatibility of Flame-Failure Equipment With Boiler Controls..... ....58—A-256

By Ross Forney, Forney Engineering Corporation, Dallas, Texas. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

If the manufacturer of flame-failure equipment, design engineer, construction superintendent, plant operator, and

maintenance foreman each does his job properly, there will certainly be compatibility of flame-failure equipment with the boiler controls. Each member of this team is dependent on the other and each must carry his share of the load. Failure of one member spells ultimate dissatisfaction with the flame-failure device. In this area of power-plant operation, a mistake by one member is very difficult to compensate for by the other members.

The author outlines the responsibility of manufacturer, design engineer, construction superintendent, plant operator, and maintenance foreman.

Application of Existing Flame-Protective Equipment to Oil and Gas Burners................58—A-279

By W. F. Lange, Mem. ASME, and John Dunn, Mem. ASME, Peabody Engineering Corporation, New York, N. Y. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Flame-protective devices presently are used as burner safeguards by scanning and proving pilot-igniter flame and main-burner flame. Much has been written covering the low-capacity, single, and dual-burner application, and this phase of the application is not discussed except to state that satisfactory performance in this category is a matter of record.

Discussion is limited to the use of flame-protective equipment on multi-burner large central-station and industrial-boiler installations. It will attempt to treat this matter from both an application and an operating point of view. The design and circuitry of the devices themselves is not discussed, and coverage is limited to the photoconductive type of units which are in most general use.

Induced Air Flows in Fuel Sprays... ....58—A-284

By Hikmet Binark, Technical University of Istanbul, Taksim, Turkey; and W. E. Ranz, University of Minnesota, Minneapolis, Minn. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Air is an important component of a spray, particularly a fuel spray. Physical and chemical rate processes in sprays are associated with and dependent on turbulent, convective, and diffusive transfer of heat, mass, and momentum between the droplets of the spray and the ambient gas. Although the transfer rates are controlled by dynamic conditions in the spray zone, the exact nature of these conditions has not been studied extensively.

Measurements of flux pattern and tip penetration velocities give only a small part of the total picture. One ought to have realistic answers to such questions as: How does the gas phase get mixed with the spray drops? What path does it follow and what are its velocities along that path? What is the nature of the momentum transfer between spray liquid and ambient gas? To begin to answer these questions, a series of experiments are reported which demonstrate qualitative and quantitative aspects of induced air flow in and near the penetration zones of hollow and solid cone sprays.

Gaps in Our Knowledge on External Deposits and Corrosion in Boilers and Gas Turbines......58—A-208

By B. A. Landry, Mem. ASME, Battelle Memorial Institute, Columbus, Ohio. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

A survey of the available information on external corrosion and deposits in boilers and gas turbines has recently been completed by Battelle for the ASME Special Committee on Corrosion and Deposits From Combustion Gases. This paper, which lists gaps in existing knowledge on this subject, is a part of the extensive report submitted to the Committee.

The author considers specifically the mechanism of deposit growth and low-temperature corrosion of economizers and air heaters. He mentions also the removal of fuel impurities as an area worthy of further research.

Investigation of the origin of deposits is noted as an area which might improve corrosion prevention.

Boiler Feedwater Studies

Some Physico-Chemical Phenomena in Supercritical Water......... ....58—A-267

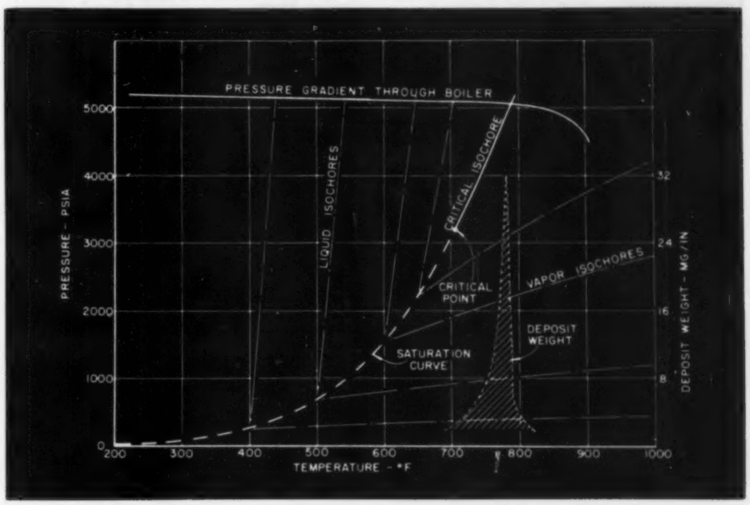
By N. L. Dickinson, Mem. ASME, W. A. Keilbaugh, and F. J. Pocock, The Babcock & Wilcox Company, Alliance, Ohio. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

There has been a continued demand on the part of the electric utilities for lower station heat rates. The knowledge that increased cycle efficiency could best be obtained by increasing the operating pressure and temperature, led The Babcock & Wilcox Company into an intensive study of the problems involved in generating steam at supercritical pressures.

Both European and past company experience indicated that proper water conditioning and control would constitute the basic criteria for successful continuous operation of a once-through supercritical unit, since most of the impurities in the feedwater would be available for deposition within the steam generator and the turbine.

To investigate the feedwater-purity requirements for units of this type, a pilot plant was constructed at the company's Research Center in 1952. During the operation of this test unit under vary-

A typical deposition curve, and a curve showing the pressure gradient through the boiler superimposed on a P-T diagram, shows that the point at which the pressure gradient curve crosses the critical isochore is approximately the temperature at which maximum deposition occurs (58—A-267)



ing conditions for the past 6 years, several phenomena were observed. Two of the more interesting of these phenomena are the subject of this paper. Test operation with regard to waterside deposition is summarized briefly and a theory presented to explain the location of some of these deposits. In addition, data are presented which show the partial dissociation of water when throttling for sampling from high pressures.

Trace Concentration of Octadecylamine and Some of its Degradation Products..............58—A-264

By G. L. Hopps, Assoc. Mem. ASME, M. E. Getz, and A. A. Berk, Bureau of Mines, U. S. Department of the Interior, College Park, Md. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

The use of octadecylamine in Federal heating systems as a filming treatment to control return-line corrosion has been indifferently successful in comparison with results reported by industry.

This paper reports the initial testing toward developing basic information on the filming treatment with the object of improving its effectiveness. The problem was complicated by the disclosure that octadecylamine is unstable in a heating system, the principal degradation products being dioctadecylamine and ammonia.

Three analytical procedures are described as used in the survey testing. A bromophenol blue colorimetric procedure determines amine nitrogen in both octadecylamine and dioctadecylamine. The secondary and primary amines are differentiated by two nonaqueous titrations, for one of which the primary amine is sequestered by low-temperature reaction with salicylaldehyde. Ammonia is determined colorimetrically by a phenolate procedure that does not develop the turbidity so frequently encountered in nesslerization.

Organic Acids for Cleaning Power-Plant Equipment.......58—A-282

By C. M. Loucks, The Dow Chemical Company, Cleveland, Ohio; E. B. Morris, American Electric Power Service Corporation, New York, N. Y.; and E. A. Pirsh, The Babcock & Wilcox Company, Barberton, Ohio. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Organic acids have properties which are of interest in connection with chemical-cleaning operations. Customarily, the "work horses" in the fields of shop pickling and on-site cleaning of industrial equipment have been inhibited sulfuric acid and inhibited hydrochloric acid. These strong mineral acids are the cheaper acids available in industry.

However, there are chemical cleaning problems in which other considerations become more important. The presence of chloride ion may be undesirable or the corrosion protection under proposed conditions of use may require special considerations.

It was of interest then to investigate the properties of certain organic acids for specific applications. Inhibited aqueous solutions of formic and citric acids have, thus far, received most of the attention.

This paper presents some of the problems that suggested the use of organic acids, reviews the results of laboratory investigations, and describes certain field applications.

Experiences With Cyclohexylamine in the Condensate - Feedwater Systems of High-Pressure Boilers... ....58—A-263

By I. B. Dick and P. C. Fritz, Consolidated Edison Company of New York, Inc., New York, N. Y. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Five years of experience with cyclohexylamine in two 900-psi boilers, over a year in two 1750-psi boilers, and about 6 months (at time of writing) in a 2020-psi boiler are reported. Within the past 2 years some improvement in cleanliness in the 900-psi units seems discernible, but to date is not conspicuous. Deposits removed from wall tubes by turbining have decreased materially. Iron and copper concentrations in feedwater have been reduced to low values. Some improvement in heater cleanliness is attributed to the amine treatment. Conclusions are that cyclohexylamine treatment imposed on boilers after a period of several years of operation did reduce iron and copper concentrations in feedwater within 6 months; that visually improved boiler cleanliness did not appear for 3 years and is not pronounced even after 5 years; that some improvement in feedwater-heater cleanliness may be expected; that no harmful results have been experienced; that cost is very small; and that, all factors being considered, the treatment should be continued.

Fluid Meters

Electromagnetic Flowmeter Primary Elements..............58—A-126

By V. P. Head, Mem. ASME, Fischer and Porter Company, Hatboro, Pa. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.;* available to Oct. 1, 1959).

An obstructionless flowmeter for electrically conducting liquids is described. Tentative design and inspection criteria which have been found to provide accuracies of $\pm 1/2$ per cent, or as little as ± 0.005 fps pipeline velocity, are set up. A practical threshold conductivity of meterable liquids is set at 20 micromhos per cm, though there is every reason to believe this will be drastically cut with further progress. Above this threshold, the flow coefficient in the volume-rate equation is shown by tests to be independent of the conductivity, of the Reynolds number, and of installation conditions.

Cavitation Effect on the Discharge Coefficient of the Sharp-Edged Orifice Plate............58—A-93

By F. Numachi, Mem. ASME, M. Yamabe and R. Oba, Tohoku University, Sendai, Japan (in type; to be published in Trans., ASME—*J. Basic Engng.;* available to Oct. 1, 1959).

The object of this paper is to investigate the effects of cavitation on the discharge coefficient of sharp-edged orifice plates with reference to various degrees of cavitation as defined by a cavitation number. The experimental data described in this paper substantiate the fact that cavitation can exist to a minimum cavitation number of 0.2 without introducing errors in the orifice discharge coefficient in excess of the normal expected accuracy.

In addition to this, it was found that the use of air-inhalation to suppress the vibration and noise from the cavitation had no effect on the discharge coefficient.

Availability List of Unpublished ASME Papers

A NUMBER of papers and reports, not preprinted or published, were presented at ASME Meetings. Manuscript copies of these papers are on file for reference purposes in the Engineering Societies Library, 29 West 39th Street, New York 18, N. Y. Photostatic copies of these unpublished papers may be secured from the Library at the rate of 50 cents per page. Microfilm copies are available at a cost of $2 for 40 pages or fraction thereof.

The following papers recently have been placed on file in the Engineering Societies Library:

1957 Annual Meeting

The Continuous Yield of Our Forests, by L. J. Markwardt

1957 Fall Meeting

Cast Nine Per Cent Nickel High Strength Steel for Low-Temperature Service, by I. B. Elman and L. M. Diran

1958 Gas Turbine Power Conference

Nuclear Reactors as an Energy Source for Gas Turbines, by L. H. Roddis, Jr.

1958 Nuclear Engineering and Science Conference

Engineering Approaches to Some Materials Problems of Nuclear Power Plant, by W. L. Fleischmann and S. L. Williams

Controlled Bowing of Fuel Subassemblies, by R. E. Petersen

1958 ASME-ARS Joint Aviation Conference

The Tailored-Interface Hypersonic Shock Tunnel, by C. E. Wittcliff, M. R. Wilson, and A. Hertzberg

1958 Instruments and Regulators Conference

Control Systems With Correlation Regulating Actions, by A. B. Chelustkin

1958 Semi-Annual Meeting

New Flexibility in Bulk Materials Handling, by I. S. Lyman

Residual Fuels and Diesel Engine Cylinder Wear, by J. M. A. Van der Horst

The Load Capacity and Attitude Angle of Gas Lubricated Journal Bearings, by M. Wildmann

Organized Storage—Clue to Warehouse Mechanization, by E. E. Moon

The Hazard Family, by J. R. Stone

Pneumatics Shelters, by C. B. Putney and M. L. Croom

Solid Material Flow From Storage Bins, by W. R. Runo

Environmental Studies for the Enrico Fermi Atomic Power Plant, by O. Hoyt Whipple and J. G. Feldes

1958 ASME-AIME Joint Solid Fuels Conference

Coal Level Controls and Stoppage Alarms, by A. J. Stock

Specific Problems Connected With Handling, and Disposing of Combustion Refuse From Solid Fuels, by L. E. Mylting

1958 Annual Meeting

Why Free Turbines? by D. P. Edkins

Effect of Lamination Thickness on the Strength of Curved Laminated Beams, by W. J. Finnorn and A. Rapavi

Medicine, Philosophy, and Management, by T. H. Hogshead

Diesel Lubricating Oils, Their Filtration, and Effect on Engine Life, by R. McBrian and L. C. Atchison

Characteristics of Smooth Running Antifriction Bearings, by T. W. Morrison and T. Tallian

Use of Nuclear Energy for Process Heat, by H. Perry and J. P. McGee

Today's Economy—A Challenge to the Operators and Designers of Oil-Field Equipment, by H. Pistole and M. E. True

Combustion Safeguards for Large Boilers Fired by Pulverized Coal, Oil, and Gas, by A. J. Poole

Epoxy Resins and Their Applications, by D. Richart, S. Richardson, and C. Pitt

Polymers are Not Products in Plastics Fabrication, by J. E. Tollar

Room Temperature Vulcanizing Silicone Rubber, by R. Treat, Jr.

Shape and Surface Factors Affecting Radiant Energy Steady States, by L. H. Shaffer

ASME TRANSACTIONS

The January, 1959, issue of the Transactions of the ASME—*Journal of Engineering for Power* (available at $1.50 per copy to ASME members; $3 to nonmembers), contains the following:

Technical Papers

Studies of Air Pollution Control by Southern California Edison Company, by A. J. Haagen-Smit. (57—SA-59)

Characteristics of Airborne Particles, by T. A. Rich. (57—SA-56)

Stage Performance and Radial Matching of Axial Compressor Blade Rows, by Jeffrey Watkins. (58—SA-21)

The Measured and Visualized Behavior of Rotating Stall in an Axial-Flow Compressor and in a Two-Dimensional Cascade, by Gino Sovran. (58—SA-20)

Availability Balance of Steam Power Plants, by C. A. Meyer, G. J. Silvestri, and J. A. Martin. (58—SA-16)

Pulverized-Coal Transport Through Pipes, by R. C. Patterson. (58—SA-24)

Operating Results of an Experimental Supercritical Steam Generator, by E. Daman, H. Phillips, J. Vail, and S. Ling. (58—SA-17)

Some Notes on the Strength of the Enrico Fermi Reactor Vessel Structure, by F. R. Beyer

Some Thoughts About the Development of Automotive Gas-Turbine Units, by A. T. Bowden and W. Hryniszak. (58—SA-26)

Electrostatic Shaft Voltage on Steam-Turbine Rotors, by J. M. Gruber and E. F. Hansen. (58—SA-5)

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COMMENTS ON PAPERS

Optimum Stocks of Maintenance Stores

Comment by O. C. Lang[1]

I HEREWITH submit a few comments which may contribute to a clearer understanding of an inventory-control system similar to the one explained in this paper.[2]

It is my impression that there is a slight error in the presentation of the total costs summarizing carrying and restocking costs, as shown in Fig. 1. If it is assumed that the restocking and carrying cost factors under consideration vary in linear fashion with inventory changes, then the lowest annual total cost is at the cross point of the two opposing cost factors.

The low point of the total cost curve should therefore be directly above this cross point. The vertical line showing the two arrows therefore should be moved to the right, whereby it intersects this cross point. The most economical order quantity expressed in dollars per order is represented by this vertical line through the cross point. I base my interpretation of the square-root formula EOQ = $\sqrt{2AK/I}$ on the postulate that the economic purchase quantity is that quantity which represents a balancing of the two opposing cost factors.

I believe it would be helpful to make this correction so as not to confuse those readers who intend to use this formula in their profession.

It is my general impression that the author minimizes the importance of the determination of the order point, indicating that "stock-out of stores items (not a spare part) is not significant as, usually, it has no effect on production." This statement has to be qualified. It is true that there are large quantities of stores items, such as painting supplies, janitor supplies, and the like in a category where a stock-out is not important. However, there are numerous other commodities held in stores, such as valves, fittings, and so on which are equally as important as spare parts for the proper maintenance of a plant. A stock-out for these latter items can be equally as embarrassing as a stock-out for a spare part. To determine stock levels on experience alone for these items can cause serious losses in production. It is therefore important that some scientific method in the determination of order points for these latter categories is adopted in order to obtain the maximum economies possible.

[1] Director, surplus control and disposal department, Union Carbide Chemicals Company, Division of Union Carbide Corporation, South Charleston, W. Va. Mem. ASME.

[2] R. E. Bley, "Optimum Stocks of Maintenance Stores," MECHANICAL ENGINEERING, vol. 80, September, 1958, pp. 51–54.

Author's Closure

We appreciate O. C. Lang's comment regarding inventory control. Contrary to his impression, the general philosophy of the economic order quantity was intentionally shown as in Fig. 1. The low point on the total cost curve, representing the economic order quantity, was purposely placed at a point other than directly above the intersect of the carrying and restocking curves since this represents the general case. In the general case, the various cost relationships may not be simple linear functions. For example, the incorporation of such factors as price change anticipation, limited shelf life, or quantity discounts can change the curve shape and intersect point.

However, in the *specific* case of the simple economic order quantity, the lowest annual total cost is at the cross point of the two opposing cost factors. This can be proved by deriving the economic order formula.

$$\text{Annual carrying cost} = \frac{IQ}{2}$$

$$\text{Annual restocking cost} = \frac{SY}{Q}$$

When these costs are equal

$$\frac{IQ}{2} = \frac{SY}{Q} \text{ or } Q = \sqrt{\frac{2SY}{I}}$$

The first derivative of the total variable costs, which represents the low point on the total cost curve, also gives

$$Q = \sqrt{\frac{2SY}{I}}$$

Thus the low point on the curve is directly above the intersect of the carrying and restocking curves in this specific case.

In regard to the establishment of order points, the determination of the optimum order point must include consideration of the cost of evaluating the economics. Using both an order point and a minimum stock level as proposed, the probability of a stock-out is greatly reduced even though the minimum stock level is established by experience alone. There are some stores items where a rigorous approach to determining stock levels is justified. These items are those that would affect production adversely and for which alternate materials or sizes are not readily available. For example, even in piping work most maintenance operations can use alternate piping materials or sizes to keep the plant operating. These items are available generally for immediate delivery from local suppliers. Generally, we have not found it justified to calculate rigorous stock levels for thousands of stores items in order to cover a small percentage of critical ones which can be handled separately.

As in the case of emergency repairs, the elimination of all emergency work indicates an excessive amount of preventive maintenance and/or spare equipment. Similarly, the elimination of all

stores stock-outs to us indicates an excessive inventory and therefore an uneconomical situation.

R. E. Bley.[3]

Control of a Job-Shop Machine Floor

Comment by Palmer Hager[4]

The scope of this subject is a broad and challenging one. It will be helpful to establish a frame of reference from which to appraise this paper.[5]

First, it is clear that a distinction must be drawn between job-shop scheduling (also often described as intermittent processing), and in-line or continuous processing. In both cases, the schedule control of the manufacturing enterprise commands the best efforts of the thoughtful and progressive entrepreneur. In the latter technology, of course, management of the control must be largely "built into" the layout of the manufacturing facility. Techniques of line and operation balancing of both component machining and assembly processes are frequently practiced. The author correctly assumes that the intermittent process shop presents the more difficult problems in terms of schedule control. His discussion of the factors which obtain, and the objectives and system-design philosophy are quite accurate.

Schedule control can be divided into three echelons of management concern and interest:

1 General management—long-range forecasting of the broad needs of manpower, facilities, and purchased materials according to the most accurate forecast obtainable. The author touches on this subject, referring to it as "Long Range Load Forecast." This procedure has been documented in the IBM publication, "Dynamic Load Forecast" Form No. 32-7916. The key point in such a procedure is the long-range nature of its results. It can help predict the need for broad management policy decisionmaking. On the other hand, it is, by its nature, too general for current week-by-week direction of the fabrication facility.

2 Thus a second echelon of operating management control must be implemented by a scheduling system. This might be referred to as intermediate or production planning scheduling. The time series applicable here is one which is equivalent to the planning cycle (e.g., eight, 12, or 20 weeks). The objective of this scheduling effort is to provide the most realistic operation schedule dates on work paper which already is well along in the production planning process. The author describes this scheduling procedure in detail. He refers to it as a "Priority Schedule" and indicates that an in-line data processing system can be sensitive to perturbations and feedback responses which are occurring day-by-day, and even hour-by-hour. In this phase of scheduling, he recognizes the conflict that usually exists between scheduling to capacity (optimal shop efficiency) and scheduling to customer satisfaction—complying with a desired, and even inviolate, scheduled completion date for components and finished products. Like other students of this subject, his proposed system seeks the happiest compromise between the two desirable objectives.

3 The third echelon of scheduling decision is sometimes referred to as "Dispatch Rules." Here we are dealing with the actual scene of operations. Decisions must now be as explicit as the following:

> **—Given a plurality of job assignments to start on the same machine, with, perhaps, the same operator skill, on the same day, which single job assignment should be made?**

The author touches on this briefly but does not elaborate to the extent which is found in the results of other studies. Dr. Ivan Rezucha, IBM Corporation, New York City, and others, are currently active in the pursuit of this area of study and their written findings are in the process of publication, under the title, "Job Shop Simulation." It is to be hoped and expected that some of the revelations from the dispatch rules studies can be used to refine the results obtainable in the other two echelons of management control of scheduling.

There are two concluding opinions which appear worthy of mention. They may be considered apart from the paper under discussion although he does touch on them briefly:

1 For a long time to come, shop schedule control must recognize the importance of customer satisfaction. This means that while a schedule completion date may be based upon an inventory replenishment policy it would ultimately be related to the date of shipment which is promised to the customer. In the most complex structures, a punch-press part may go into something—which goes into something—which goes into something—and so on, until the customer's item is ready for shipment. In this chain of events, it is too often true that "for the want of a nail, the kingdom will be lost."

2 A great deal of real world experimental and developmental systems experience must be built up around the small evolutionary improvements which we can make in the scheduling process. The process of "juggling" to find the best fit is attractive in theory, but mathematical techniques to describe this phenomenon are sparse in their exposition, or nonexistent. One gets a small glimpse of the magnitude of this problem when he realizes that, for just six shop orders to be juggled in a single-entry cycle, six factorial, or 720, trials would have to be made. Since six orders are scarcely in the ball park of the daily volume of even the smallest shop, it is clear that we will have to be satisfied with "small favors" while we continue to strive for an optimal solution.

Author's Closure

I concur wholeheartedly with the views expressed by the discusser of my paper.

Of particular significance is the "frame of reference" which he constructs in order to give the proper vantage point from which to judge the effectiveness of the proposed data processing system. I recommend its reading to anyone who may have had difficulty putting my paper into proper perspective.

As he points out, the shop controlling data processing system proposed in my paper is aimed at the "intermediate or production planning" scheduling of an intermittent processing or job-shop type of operation. The key problem in such scheduling is the conflict between scheduling to capacity and scheduling to "customer satisfaction" (or scheduling to inventory needs as I identified it). My answer to this dilemma is to avoid building into the system itself any irrevocable advance commitment as to the weighting to be given these two, often conflicting goals. In a nutshell it is this philosophy which led to the type of scheduling and load forecasting described in my paper. The outstanding feature of this system is the ability to vary at will the relative weighting to be given the inventory (customer satisfaction) needs and the

[3] Consultant supervisor, maintenance consultant, engineering department, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del.

[4] Manager, manufacturing control education department, International Business Machine Corp., Endicott, N. Y.

[5] William R. Elmendorf, "Control of a Job-Shop Machine Floor," Mechanical Engineering, vol. 80, October, 1958, pp. 61–64, condensed from Paper No. 58—Prod-3.

capacity limitations in preparing the machine floor schedules.

W. R. Elmendorf.[6]

Beryllium Machining Characteristics

Comment by Erwin G. Loewen[7]

It would appear from this paper[8] that turning beryllium by conventional methods presents no great problem except for removal of dust. I would be curious to know whether tapping, which causes so much trouble with titanium, presents any difficulties with beryllium. Sawing and especially grinding would seem to be areas where beryllium might present some awkward problems. Has this turned out to be the case?

[6] International Business Machines Corporation, Yorktown Heights, N. Y.

[7] Technical director, The Taft-Peirce Manufacturing Company, Woonsocket, R. I. Mem. ASME.

[8] D. R. Walker, "Beryllium Machining Characteristics," Mechanical Engineering, vol. 80, August, 1958, pp. 57–62.

Author's Closure

As stated in the paper,[8] I agree with Dr. Loewen that beryllium can be readily turned, providing adequate protection against its toxicity is achieved. Only a limited amount of beryllium tapping has been done at AVCO, primarily because the brittleness of the material generally dictates the use of other joining methods. Tapping has presented no significant problems. Beryllium sawing requires high unit pressure on the individual saw teeth. For example, for one sawing application, six out of each seven teeth on a heavy duty, six teeth per inch, bandsaw had to be removed to obtain effective cutting of an 8-in-deep section [3].[9] No studies have as yet been made of beryllium grinding operations.

D. R. Walker.[10]

[9] Number in brackets designates Reference in the paper.

[10] Research and Advanced Development Division, AVCO Manufacturing Corporation, Lawrence, Mass. Assoc. Mem. ASME.

BOOKS RECEIVED IN LIBRARY

Missile Engineering Handbook
By C. W. Besserer. 1958, D. Van Nostrand Company, Inc., Princeton, N. J. 600 p., $7^1/_4 \times 10^1/_4$ in., bound. $14.50. Primarily useful for preliminary design and parametric studies, this handbook is orgainized into ten sections. The first nine comprise design data dealing with the properties of the atmosphere; environmental data and reliability; properties of materials and structures; aerodynamics; avionics; propulsion; space flight. The final section, a substantial part of the volume, consists of a glossary of terms relating to guided missiles and space flight. This is the fourth volume of the series, "Principles of Guided Missile Design."

Motion and Time Study Applications
By Ralph M. Barnes. Third edition. 1958, John Wiley & Sons, Inc., New York, N. Y. 188 p., $8^1/_2 \times 11$ in., paper. $3.50. A collection of case studies relating to specific situations. It is intended to be both a reference manual and a work book. Its usefulness is increased by correlating many of the case studies with motion and time-study films available. Also included are two sheets of film enlargements for those interested in micromotion analysis.

Natural Aerodynamics
By R. S. Scorer. 1958, Pergamon Press, New York, N. Y. 312 p., $5^1/_2 \times 8^3/_4$ in., bound. $9. A study of the physical principles and processes of fluid motion. Topics discussed include vorticity, viscosity, boundary layers, wakes and turbulence, buoyant convection, plumes and jets, air waves, and clouds and fallout. Much of the material contained is of interest to the person working with air-pollution problems.

Performance of Metal Cutting Tools
By R. Tourret. 1958, Butterworths Scientific Publications, Toronto, Canada. 184 p., $6^1/_4 \times 10$ in., bound. $10. The author has gathered together information on the mechanical and physical performance of metal-cutting tools. Aspects discussed include the theory of continuous-type chip formation, tool life, and surface finish. There is a bibliography of 158 references.

Principles of Noise
By J. J. Freeman. 1958, John Wiley & Sons, Inc., New York, N. Y. 299 p., $6 \times 9^1/_4$ in., bound. $9.25. Covers such areas as probability, stationary random processes, physical sources of noise, equivalent noise generators, noise factor, measurement of a direct voltage, Gaussian random processes, the detection of alternating wave forms, and target noise.

Recent Advances in the Engineering Sciences: Their Impact on Engineering Education
Published 1958 by the McGraw-Hill Book Company, New York, N. Y. 257 p., $6^1/_4 \times 9^1/_4$ in., bound. $4.75. Surveys the educational implications of a number of expanding areas including automation and automatic control; operations research and systems engineering; thermodynamics; mass, momentum, and heat transfer; nuclear engineering; solid state physics and engineering materials; computer development and applications. The book is a report of the proceedings of the Conference on Science and Technology for Deans of Engineering, held at Purdue University in September, 1957.

Scientific Programming in Business and Industry
By Andrew Vazsonyi. 1958, John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 474 p., $6^1/_4 \times 9^1/_4$ in., bound. $13.50. The author attempts to present the technique of scientific programming in terms of a mathematical language understandable by businessmen. An extensive review of the fundamentals of linear programming is given, including the simplex method, the dual theorem, geometry, convex and dynamic programming, and the elements of the theory of games. Specific applications discussed are transportation allocation and production and inventory control.

Technology of Instrumentation
By Eric B. Pearson. 1958, D. Van Nostrand Company, Inc., Princeton, N. J. 202 p., $5^3/_4 \times 8^3/_4$ in., bound. $4.75. The basic principles of measurement by means of an instrument with moving parts is studied first, along with the parameters determining its static and dynamic accuracy. Servomechanisms and methods for improving their performance, the different ways of instrumenting position-control systems in practice, and the problem of stability are then discussed.

ASTM Specifications for Steel Piping Materials
Prepared by ASTM Committee A-1 on Steel. 1958, American Society for Testing Materials, Philadelphia, Pa., 468 p., 6×9 in., paper. $5. Contains 62 standards for carbon-steel and alloy-steel pipe and tubing. Specific applications covered are pipe used to convey liquids, vapors, and gases at normal and elevated temperatures; still tubes for refinery service; heat exchanger and condenser tubes; boiler and superheater tubes; castings, forgings, bolts and nuts.

Advances in Applied Mechanics, Vol. V.
Edited by H. L. Dryden and Theodore von Kármán. 1958, Academic Press, Inc., New York, N. Y. 459 p., $6^1/_4 \times 9^1/_4$ in., bound. $12. Papers dealing with supersonic air ejectors; unsteady airfoil theory; theory of distributions; stress wave propagation in rods and beams; problems in hydromagnetics; mechanics of granular matter; condensation in supersonic and hypersonic wind tunnels.

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Ausbeulen; Theorie und Berechnung von Blechen

By Curt F. Kollbrunner and Martin Meister. 1958, Springer-Verlag, Berlin, Germany. 344 p., $6\frac{1}{2} \times 9\frac{1}{4}$ in., bound. 42 DM. Following a chapter on the theory of buckling, there is a long section presenting detailed analyses of a variety of examples in both the elastic and plastic ranges. Stiffened rectangular plates for structural use are dealt with, and the last two short sections discuss plates with various loadings and what the authors call the "supercritical range" between the buckling point and the breaking point.

Causes and Prevention of Corrosion in Aircraft

By T. C. E. Tringham. 1958, Sir Isaac Pitman & Sons, Ltd., London, England. 124 p., $5\frac{1}{2} \times 8\frac{3}{4}$ in., bound. 25 s. Considers such aspects as causes and prevention of corrosion in engines; corrosion in electrical equipment; the electroplating process; anodic oxidation of aluminum and chromating of magnesium; metallizing processes; paints, enamels, varnishes and resins for protecting aircraft components; nondestructive examination.

Centralized Information Services

By Allen Kent and James W. Perry. 1958, The Press of Western Reserve University, Cleveland, Ohio; distributed by Interscience Publishers, New York, N. Y. 156 p., $8\frac{1}{2} \times 11$ in., paper. $5. An investigation of the possibilities of centralized information services was carried out by means of questionnaires sent to persons engaged in these activities. Despite varying conceptions of goals to be achieved, one of the conclusions reached seemed to indicate dissatisfaction with present services. The authors suggest the preparation of detailed descriptions and models of centralized and co-operative information processing activities.

Conference on the Peaceful Uses of Atomic Energy, Proceedings

Co-sponsored by the Japan Atomic Industrial Forum, and by the Atomic Industrial Forum, Inc., New York, N. Y. 318 p., $8\frac{1}{4} \times 11\frac{3}{4}$ in., paper. $5. Following a discussion of the development and uses of atomic energy in Japan and the Far East, there are sections devoted to the economics and technology of power reactor systems; reactor fuels, materials and components; test, research, and propulsion reactors; application of radiation and radioisotopes in industry; facilities for handling and working with radiation. The conference was held in Japan in May, 1957.

The Elevated-Temperature Properties of Weld-Deposited Metal and Weldments

Published 1958 as Special Technical Publication No. 226 by the American Society for Testing Materials, Philadelphia, Pa. 223 p., $8\frac{1}{4} \times 11$ in., paper. $5. Provides data for carbon, low-alloyed and austenitic steels, and for complex alloys developed for high strength at high temperatures. Among the data included are short-time tensile properties, creep and rupture strength, and chemical composition.

ASME BOILER AND PRESSURE VESSEL CODE

Interpretations

The Boiler and Pressure Vessel Committee meets regularly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th St., New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in Mechanical Engineering.

(The following Case Interpretations were formulated at the Committee meeting October 31, 1958, and approved by the Board on December 29, 1958.)

Erratum

Case No. 1205-3 (Reopened) (Special Ruling), subparagraph number 5 of the Reply reference to UF-31(d) should be revised to read UF-31(b)(1)(a).

Annulment of Cases

Case No.	Reasons for Annulment
1174	Stress values now included in Table UNF-23
1199	Lack of use
1202	Essence of Case has been included in revisions to Pars. UCS-56 and UCS-57

Case No. 1177-3
(Reopened) (Special Ruling)
(Expansion Joints)

Inquiry: Expansion joints are being used in pressure vessel installations. The Code makes no specific provisions for them. Under what conditions may an expansion joint be used as an integral part of a Code pressure vessel?

Reply: The Code does not contain rules for the design of expansion joints but such joints may be used under the conditions of Par. U-2(c) giving due consideration to Par. UG-22. When the expansion joint is manufactured by other than the vessel manufacturer, the manufacturer of the joint shall execute a partial data report as required by Par. UG-120(b) using Form U-2 as far as applicable. The joint shall be stamped with the manufacturers serial number but shall not be stamped with the Code Symbol. The partial data report, in addition to recording the joint serial number, shall identify the vessel manufacturer and specific vessel for which the expansion joint is intended. The joint shall be shop inspected during fabrication by a qualified inspector who shall sign the partial data report; this inspection is limited to include materials, fabrication and such details are covered by the Code rules except that the inspection of the expansion element covers material and workmanship only. The certificate of shop inspection shall be modified to read "We certify the above data to be correct and that all details of material, construction and workmanship of the object conform to ASME Code requirements for parts, except that the inspection of the expansion element covers material and workmanship only." The final vessel manufacturer shall have the responsibility for satisfying the final inspector under the provisions of Par. U-2(c); he shall obtain such supporting data as he may need from the joint manufacturer. This plus the partial data report will enable the final inspector to authorize application of the Code Symbol to the completed vessel.

Note: In considering the acceptability of joints under Par. U-2(c) in combination with Pars. UG-22 and UG-23, it is not the intent that the combination of

direct and localized and secondary bending stress need be held to the Code tabulated allowable stress, although the direct (membrane) stress must be held to the tabulated maximum allowable stress value. The Committee recognizes that such localized stresses primarily influence fatigue performance and it is intended that the manufacturer and inspector will exercise reasonable judgment in assessing a joint for an individual application. Footnote 2 to Par. UG-23(b) recognizes that high localized and secondary bending stresses may exist in Code vessels and the stresses inherent in accepted details can be of assistance as a guide.

Case No. 1238-1 *(Reopened)(Special Ruling)* (Intermediate Containment Vessels)

Revise the Reply *to read as follows:*

It is the opinion of the Committee that intermediate containment pressure vessels surrounding the reactor vessel which are not required to retain radioactive materials under normal operating conditions, need not be built in accordance with special requirements for vessels containing lethal substances. All other intermediate containment pressure vessels surrounding the reactor vessel shall be considered to fall under the category of those containing lethal substances but still may be built without stress-relieving required in Par. UW-2(a) provided the requirements of Case No. 1226, omitting Par. 1 are met.

Case No. 1255 *(Special Ruling)* (SA-350 Grade LF-1 Forgings with Added Nickel)

Inquiry: May forgings be used under the rules of Sections I and VIII of the ASME Boiler and Pressure Vessel Code which conforms to Section II, Material Specification SA-350, Grade LF-1 with the following exceptions:

(1) *Chemical Requirements* In addition to the chemical requirements of the specification, the material shall include 1.0 to 2.0 per cent nickel.

(2) *Heat Treatment* For material over 3 inches in thickness, the heat-treatment may consist of accelerated cooling and tempering to provide a structure comparable to that obtained in lesser thicknesses by normalizing.

(3) *Inspection* When accelerated cooling is employed, all surfaces of the part shall be inspected for injurious defects by magnetic particle or penetrant oil methods.

Reply: It is the opinion of the Committee that forgings conforming to the requirements outlined in the Inquiry may be used under the rules of Sections I and VIII, with allowable stress value of 15,000 psi for temperatures between −20 and 650 F.

Case No. 1256 *(Special Ruling)* (Carbon Steel Plate with Improved Transition Properties)

Inquiry: Modifications have recently been made in requirements for chemistry and steel-making practices to obtain improved transition properties in carbon steel hull plates for merchant ships. What modifications can be made to provide similar improvement in flange quality carbon steel plate for Code construction?

Reply: It is the opinion of the Committee that carbon steel plate made in accordance with the following requirements for improving transition properties may be used in pressure vessels constructed in accordance with either Section I or Section VIII of the Code and to which the Code stamp is applied. All other requirements now in the code apply.

CHEMICAL REQUIREMENTS

			Grade 55*	Grade 60*
Carbon, max, per cent	1 in. and under		0.22	0.24
	Over 1 in. to $1^1/_2$ in., incl.		0.24	0.27
**Manganese, per cent	1 in. and under	Ladle	0.80 to 1.10	0.80 to 1.10
		Check	0.76 to 1.14	0.76 to 1.14
	Over 1 in. to $1^1/_2$ in., incl.	Ladle	0.60 to 0.90	0.60 tp 0.90
		Check	0.56 to 0.94	0.56 to 0.94
Phosphorus, max, per cent			0.04	0.04
Sulfur, max, per cent			0.05	0.05
**Silicon, per cent	Over 1 in. to $1^1/_2$ in., incl.	Ladle	0.15 to 0.30	0.15 to 0.30
		Check	0.13 to 0.33	0.13 to 0.33

* Plates over 1 in. shall be made to fine grain practice. They may be required to be normalized if so specified.

** The same silicon and manganese content which is required for thicknesses over 1 in. may be applied for thicknesses of 1 in. and under provided the steel is made to fine grain practice.

TENSILE REQUIREMENTS

	Grade 55	Grade 60
Tensile strength, psi	55,000 to 68,000	60,000 to 74,000
Yield point, min, psi	30,000	32,000
Elongation in 8 in., min, per cent	24	22
Elongation in 2 in., min, per cent	28	25

BEND DIAMETERS

(Ratio of inside diameter of bend to thickness of specimen)

	Grade 55	Grade 60
1 in. and under	1	1
Over 1 in. to $1^1/_2$ in., incl.	1.5	1.5

OTHER REQUIREMENTS

(1) Plates shall otherwise conform to ASME specification SA-285 Flange quality for thicknesses up to and including 1 in. and to SA-201 Flange quality for heavier thicknesses.

(2) The following maximum stress values apply:

For Code Section	Grade	Spec Min Tensile	For Metal Temp Not Exceeding Deg F: −20 to 650	700	750	800	850
I	55	55,000	13,750	13,250	12,050	10,200	7,800
I	60	60,000	15,000	14,350	12,950	10,800	7,800
VIII	55	55,000	13,750	13,250	12,050	10,200	8,350
VIII	60	60,000	15,000	14,350	12,950	10,800	8,650

(3) For welding, all Code requirements applicable to ASME Specification SA-285 apply. The base material is assigned to Classification P-1.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

As NEED arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Tri-

ennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Power Boilers, 1956

FORMS P-2, P-3, and P-4A *Manufacturer's Data Report Forms* These forms are being revised to include the following:

(a) We certify that the field assembly of all parts of this boiler conforms with the requirements of Section I of the ASME Boiler and Pressure Vessel Code.
(b) Date
(c) Signed (Assembler)
(d) By (Representative)
(e) Our Certificate of Authorization to use the (A) or (S) Symbol expires (Space for inclusion of date).

When available, copies may be obtained from the Secretary, ASME Boiler and Pressure Vessel Committee, 29 West 39th St., New York 18, N. Y., for comment only.

PAR. P-112(a)(4) *Welded Connections* Revise to read:

The diameter and thickness limitations shall apply independently. A weld will not be considered as subject to:

(a) Radiant heat from the furnace when in a portion of a tube that has five or more rows of tubes between it and the furnace.
(b) Furnace gases when in a zone where the design temperature of these gases does not exceed 850 F.

Material Specifications, 1956

SPECIFICATION SB-171 (Based on ASTM Specification B 171-55) Revise to read:

PAR. 1 In the second line, revise "five" to "seven."

TABLE I Add "aluminum bronze, alloys D and E."

TABLE II After "70-30 copper-nickel alloy" add "over 2.5 to 5, inclusive and its properties."

Add "aluminum bronze, alloys D and E."

TABLE V Add "aluminum bronze."

Heating Boilers, 1956

PAR. H-58 *Temperature Combustion Regulators* Revise to read:

In addition to the mandatory requirements for a pressure relief device required by Pars. H-44 and H-97, each hot-water heating or hot-water supply boiler shall be fitted with a temperature actuated control, which will control the rate of combustion to prevent the temperature of the water from rising above 250 F at or near the boiler outlet.

PAR. H-59 *Pressure Combustion Regulators* Revise to read:

When a pressure-actuated combustion control is used on a steam boiler, it shall operate to prevent the steam pressure from rising above 15 psi.

PAR. H-111 *Temperature Combustion Regulators* Revise to read as shown in Par. H-58 given above.

PAR. H-112 *Pressure Combustion Regulators* Revise to read as shown in Par. H-59 given above.

Unfired Pressure Vessels, 1956

PAR. UW-19(a)(2) Revise to read:

The required thickness of the plate shall not exceed $1^1/_2$ in., but if greater than $^3/_4$ in., the staybolt pitch shall not exceed 20 in.

Part UB has been too extensively revised to be included in full in MECHANICAL ENGINEERING, but copies may be obtained from the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th St., New York 18, N. Y.

PAR. UCS-11(c) Revise to read:

Nuts shall be semi-finished, chamfered and trimmed. For use with flanges conforming to the standards listed in Par. UG-44, nuts shall conform at least to the dimensions given for the American Standard ASA B18.2-1955 for Heavy Series Nuts. For use with connections designed in accordance with the rules in Appendix II, nuts may be of the American Standard Heavy Series, or they may be of other dimensions provided their strength is equal to that of the bolts, giving due consideration to bolt hole clearance, bearing area, thread form and class of fit, thread shear, and radial thrust from threads (see Par. U-2(c)).

PAR. UCS-25 *Corrosion Allowance* Last sentence, delete and substitute the following:

This requirement does not apply to vessels built in accordance with Table UW-12, Column C. The minimum required thickness of $^1/_4$ in. for unfired steam boilers (see Par. UCS-16(b)) may include the corrosion allowance specified by this rule.

Fig. UA-48 *Type of Flanges* Sketch (1), correct to show dimension *B* to the inside of the ring flange to agree with the definitions in the Code.

Welding Qualifications, 1956

PAR. Q-3(a)(5) *Horizontal Fixed Position* 5G Revise to read:

Pipe with its axis horizontal and with the welding groove in a vertical plane. Welding shall be done without rotating the pipe so that weld metal is deposited from the flat, vertical and overhead positions (see Fig. Q-3(a)).

PAR. Q-13 *Type and Number of Test Specimens* Revise the second sentence to read:

Qualification on pipe shall qualify for plate but not vice versa.

PAR. Q-24(a) *Type and Number of Test Specimens* Replace the second sentence with the following:

(1 Qualification on single welded plate with a backing-up strip shall also qualify for single welded pipe with a backing-up strip and vice versa in positions 1G and 2G only.
(2) Qualification on single welded plate without a backing-up strip shall also qualify for single welded pipe without a backing-up strip and vice versa in position 1G and 2G only.
(3) Qualification on double welded plate shall also qualify for double welded pipe and vice versa in positions 1G and 2G only.
(4) For all other positions qualification on pipe shall qualify for plate but not vice versa.

PAR. Q-24(c) Revise to read:

For test welds made in pipe in positions 1G or 2G of Fig. Q-(QN)-3, specimens shall be removed as shown for bend specimens in Fig. Q-(QN)-13.2(a) or (b) at approximately 90 deg apart, omitting the tension specimens shown. For test welds made on a pipe in position 5G of Fig. Q-(QN)-3, specimens shall be removed in accordance with Fig. Q-(QN)-13.2(a) or (b) and all four specimens shall pass the test. Face-bend tests shall be made when required, on the specimens from the top and one side. Root-bend tests shall be made, when required, on the specimens from the bottom and the other side.

PAR. QN-3(a)(5) *Horizontal Fixed Position 5G* Revise as given in Par. Q-3(a)(5) as given above.

PAR. QN-13 *Type and Number of Test Specimens* Revise as given in Par. Q-13 as given above.

PAR. QN-24(a) *Type and Number of Test Specimens* Revise as given in Par. Q-24(a) as given above.

PAR. QN-24(c) Revise as given in Par. Q-24(c) as given above.

Current Engineering Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP

Engineers' Salaries, 1956–1958, Show Strong Upward Trend in EJC Study

In recent years, Engineers Joint Council has conducted various studies related to the economic status of engineers. The third in its study series on "Professional Income of Engineers" was published in mid-January, 1959, and presents one of the most comprehensive analyses of engineering earnings ever completed in the United States. Copies are available from EJC, 29 West 39th Street, New York 18, N. Y., at $3 each.

EJC made studies on starting salaries of engineering graduates by fields of employment in 1949 and 1950, and annually thereafter in connection with the "Demand for Engineers" studies of the Engineering Manpower Commission.

During 1949 and 1950, a specialized study was made by EJC on behalf of the Department of Defense. Income and other information obtained in the study were analyzed and published by the Bureau of Labor Statistics in 1952 under the title "Employment, Education, and Income of Engineers, 1949–1950—A Survey of Engineering Society Members of Full Professional Grade."

The utility of these studies was limited because of the restrictive nature of the participants; i.e., members of certain engineering societies. Other specialized studies conducted by various societies served many useful purposes but failed to provide data representative of the entire engineering profession. Such surveys are normally conducted among individuals, and the response may be subject to the process of self-selection and, therefore, not broadly representative.

Realizing the lack of recent and comprehensive data on engineering income, in 1953 EJC decided to undertake a series of studies in this area. The studies are presentations of earnings of engineering graduates reported by their employers in industry and government. The collection of data for engineering educators is made on an individual basis.

The first report of the series, "Professional Income of Engineers," was completed by EJC in 1953, the second in 1956. (See Mechanical Engineering, March, 1957, pp. 316–318.) It was agreed initially that the interval between surveys would be three years. However, responding to unprecedented requests from organizations and individuals for updated information, it was decided that a third survey would be conducted in 1958. It is generally considered that in order to reflect changing economic conditions, surveys should be conducted biannually, as will now be the policy of EJC.

In 1957 the EJC survey activities

Table 1 Annual Earnings in Dollars of Engineers

	1958	1957	1956	1955	1954	1953	1952	1951
Highest	16500	15500	15650	16500	17650	18750	18750	20000*
Upper Decile	6775	7150	7700	8250	8700	9150	9700	10300
Upper Quartile	6400	6625	7075	7475	7875	8225	8700	9125
Median	**5925**	**6175**	**6525**	**6850**	**7050**	**7450**	**7725**	**8125**
Lower Quartile	5575	5750	6075	6275	6450	6750	7025	7300
Lower Decile	5250	5400	5650	5950	6000	6225	6475	6625
Lowest	4000†	4000†	4000†	4000†	4000†	4000†	4000†	4000†

Table 2 Annual Earnings in Dollars of Engineers

	1958	1957	1956	1955	1954	1953	1952	1951
Highest	10500	14500	10500	12500	11500	11750	12650	13500
Upper Decile	6150	6650	7150	7675	8275	8375	9525	9475
Upper Quartile	5800	6175	6700	6925	7550	7750	8100	8550
Median	**5350**	**5675**	**6075**	**6400**	**6700**	**6850**	**7075**	**7675**
Lower Quartile	5000	5175	5375	5700	6050	6150	6325	6650
Lower Decile	4525	4675	4500	5150	5525	5600	5725	6000
Lowest	4000†	4000†	4000†	4000†	4000†	4000†	4000†	4000†

Table 3 Annual Earnings in Dollars of College

	1958	1957	1956	1955	1954	1953	1952	1951
Highest	6500	8375	8250	12500	10500	16650	16500	19500
Upper Decile	‡	6500	6975	7275	7925	8750	9375	9925
Upper Quartile	5800	5950	6475	6500	7000	7350	8300	8675
Median	**5600**	**5425**	**5700**	**5950**	**6225**	**6400**	**7100**	**7425**
Lower Quartile	4250	4825	4975	5150	5475	5300	5800	6375
Lower Decile	‡	4250	4400	4600	4875	4675	5100	5450
Lowest	4000†	4000†	4000†	4000†	4000†	4000†	4000†	4175

† Less than $4,000.
‡ Insufficient data for calculation.
* More than $20,000.

were assigned to the Engineering Manpower Commission. EMC conducted the current survey and published this report on behalf of the Council.

The growing interest and acceptance of the EJC studies are evidenced by the increasing number of participants. The 1958 report presents the most comprehensive and representative sample of engineering earnings ever published in the United States.

The brief history of the studies is summarized as follows:

Survey Year	Industry Companies	Industry Engineers
1953	295	65,169
1956	346	93,123
1958	546	155,124

	Government Agencies	Government Engineers
1953	12	3,892
1956	38	4,081
1958	131	30,028

	Educators Engineers
1953	2,904
1956	4,081
1958	5,658

	Total Engineers	Increase Per cent
1953	71,965	..
1956	107,832	50
1958	190,810	77

Following the pattern established in previous reports (1953, 1956) the 1958 publication presents annual earnings of engineering graduates related to year of entry into profession (baccalaureate year) for those employed in industry, government, and education. The tables and corresponding charts include the following earning for each classification and year: Highest and lowest; upper and lower quartiles and deciles; and medians. In addition, the sample representation for each time interval classified is reported with the numbers earning "$20,000 and over" and earning less than $5000.

The EJC studies revealed a strong upward trend in earnings in industry between 1953 and 1956. Although industry, particularly, was adversely affected by the recent recession, this upward trend in earnings continued at a slightly reduced rate.

National Engineers' Week

Annually, since 1951, the National Society of Professional Engineers has been promoting a National Engineers' Week—this year, February 22–28. The society chose the calendar week in which the birth date of George Washington falls for a twofold purpose: to commemorate the engineering and building achievements of the first president of the United States and the many contributions made by engineers to society.

Leading engineering figures from industry, education, private practice, government service, and the military will act as sponsors of this year's events.

They are: Wernher von Braun, Army Ballistic Missile Agency; Allen B. DuMont, Allen B. DuMont Laboratories, Inc.; T. Keith Glennan, Case Institute of Technology, and administrator, NASA; Major General Emerson C. Itschner, chief of engineers, United States Army; James R. Killian, Jr., special assistant to the President of the United States for science and technology; Clarence H. Linder, Mem. ASME, General Electric Company; Thomas E. Murray, Fellow ASME, consultant, Joint Committee on Atomic Energy; Granville M. Read, Mem. ASME, E. I. du Pont de Nemours & Company, Inc.; Rear Admiral H. C. Rickover, ASME George Westinghouse Medalist, chief of Naval Reactors Branch, U. S. Atomic Energy Commission, and assistant chief Navy's Bureau of Nuclear Propulsion; Royal W. Sorensen, California Institute of Technology; Philip Sporn, Hon. Mem. ASME, American Gas and Electric Company; David B. Steinman, consulting engineer; Bertram D. Tallamy, Federal Highway Administrator; and Charles Allen Thomas, Monsanto Chemical Company.

in Industry by Year of Entry Into the Profession

1950	1949	1947–48	1945–46	1940–44	1935–39	1930–34	1925–29	1920–24	1915–19	Thru 1914
20000*	20000*	20000*	20000*	20000*	20000*	20000*	20000*	20000*	20000*	20000*
10675	11350	12225	13525	14500	16750	18000	19425	20000*	20000*	20000*
9450	10000	10675	11300	12325	13750	14125	14775	15200	16000	15250
8450	**8825**	**9325**	**9675**	**10450**	**11300**	**11350**	**11225**	**11850**	**11000**	**11000**
7550	7825	8225	8525	9000	9475	9400	9250	19700	9325	8600
6825	7075	7350	7525	7925	8050	7925	8250	8200	7800	7500
4000†	4175	4000†	4250	4000†	4000†	4000†	4000†	4000†	4000†	4000†

in Government by Year of Entry Into the Profession

1950	1949	1947–48	1945–46	1940–44	1935–39	1930–34	1925–29	1920–24	1915–19	Thru 1914
13500	14500	14500	15750	17650	19650	20000*	20000*	20000*	20000*	20000*
9675	9875	11225	11175	12075	12225	12550	12750	12425	12750	12200
8575	8875	9550	9350	10850	11025	11250	11675	11300	11300	10800
7775	**8050**	**8325**	**8250**	**9050**	**9225**	**9325**	**9575**	**9425**	**9350**	**9225**
6825	6950	7425	7200	8000	8150	8150	8125	8175	8100	7950
6200	6225	6425	6400	6825	7125	7250	7350	7500	7025	6650
4000†	4000†	4000†	4000†	4000†	4000†	4000†	4000†	4000†	4075	4000†

Educators by Year of Entry Into the Profession

1950	1949	1947–48	1945–46	1940–44	1935–39	1930–34	1925–29	1920–24	1915–19	Thru 1914
15500	20000*	20000*	20000*	20000*	20000*	20000*	20000*	20000*	20000*	20000*
10400	11375	12150	12850	15250	17600	17700	17325	17625	16800	16000
8875	9800	10175	10725	12175	13375	13950	12750	13050	12950	11325
7500	**8275**	**8625**	**8950**	**9875**	**10650**	**10850**	**10050**	**10650**	**9950**	**9175**
6375	6925	7375	7575	8200	8450	8450	8150	8625	7725	7600
5450	6050	6450	6525	7000	6925	6875	6575	7025	6450	5900
4175	4000	4625	4000†	4250	4675	4175	4250	4100	4750	4250

MEETINGS OF OTHER SOCIETIES

Feb. 16–17

Marquette University, College of Engineering, conference on heating, air conditioning, and refrigeration, Marquette University, Milwaukee, Wis.

Feb. 25–26

U. S. Atomic Energy Commission and Kansas State College, midwest industrial radioisotopes conference, Kansas State College, Manhattan, Kan.

March 3–5

IRE, AIEE, and Association for Computing Machinery, western joint computer conference, Fairmont Hotel, San Francisco, Calif.

March 16–20

American Society for Metals, western metal exposition and congress, Pan-Pacific Auditorium and Ambassador Hotel, Los Angeles, Calif.

(*For ASME Coming Events, see page 132*)

AAAS Section M (Engineering) Program Airs National and International Aspects of Systems of Units

By Carl F. Kayan, Mem. ASME[1]

During the 125th Annual Meeting of the American Association for the Advancement of Science, Section M (Engineering) held a four-session meeting in Washington, D. C., on Dec. 29 and 30, 1958. Twenty-eight authorities from the United States and overseas contributed papers on the meeting theme, "National and International Aspects of Systems of Units."

The subject covered the problems of (*a*) English versus Metric Units and (*b*) Absolute versus Gravitational (Technical) Systems. It included further, treatment of the MKSA System (meter, kilogram-mass, second, and ampere: i.e., Absolute basis) which recently has been adopted by a number of foreign nations and is also being seriously considered by others. One particular feature of the MKSA System, by way of distinguishing characteristic, is that it embodies the use of the Joule for energy and the watt (or kilowatt) for energy-rate.

The purpose of the program in Washington was primarily to focus attention on the growing problems of international usages and goals in terms of the different systems employed as contrasted to those of our own national operations tied to established general and public practices. It was not intended that the purpose of the program itself be to push for the adoption of any one procedure at this time or that any one system was to be "crusaded," but rather, and with vigor, now to "alert" the technologists on the general confused situation and of the increasing clamors, needs, and proposals to ameliorate it. Many now think that the problems of unit-usages can no longer be "swept under the rug"; that they must be recognized and be dealt with both objectively and subjectively.

Presentation of authoritative viewpoints was invited to cover the various angles of unit systems and practices, including the ideas of standardization and of decimalization within our own Anglo-American systems along with possible proposals for unification and simplification. The Committee sought to be mindful of the needs of practical operations versus those of general technology; of civilian versus military aspects.

Obviously the economic consequences of industrial and public change-over from the Anglo-American system to a metric system would be colossal. Measured against this viewpoint are the pressures of international trade which are becoming greater as the manufacturing and export potential of underdeveloped countries increases, yielding growing competition for foreign markets. Furthermore, interchange of technical information would be greatly facilitated by the adoption of some universal system of units. Although we ourselves in this country have a decimalized currency and are thus accustomed to the use of decimals, we are hamstrung by the awkward use of fractions in many fields and, worse, our primary-school educational programs are cluttered up with the needless teaching detail accorded fractions. Decimalization could be a first step toward a form of international standardization, would make some of our odd units less difficult to take, and probably would make our own usages less expensive a burden.

Dr. A. H. Hughes of the British Association Metric Committee personally presented his paper dealing with the British problems growing out of the unit-system confusion. Much sentiment was voiced favoring a universal unit system, but with speakers from U. S. industry emphasizing the advantages and development of the use of the inch and its decimals for manufacturing operations.

Many leaders from the fields of engineering and science, including authorities from the National Bureau of Standards, as well as invited scientific representatives from the various foreign embassies in Washington, were present.

It is also to be noted that, since the meeting, on Jan. 1, 1959, official announcement was made by the National Bureau of Standards of reconciled standards value of the inch as equal to 2.54 centimeters and the pound equal to 0.45359237 kilograms. The new international standards will be used in all measurement calibrations carried out by the standard-setting laboratories of Australia, Canada, New Zealand, South Africa, the United Kingdom, and the United States after July 1, 1959.

[1] Professor, Department of Mechanical Engineering, Columbia University, who served as chairman of the Section M Program Committee.

Seven Science Attachés Fill Key U. S. Embassy Posts

Walter Ramberg, Mem. ASME, chief, Mechanics Division, National Bureau of Standards, is one of seven appointed as science attachés at key embassies. Wallace R. Brode, science adviser to the Secretary of State, in making the appointments, filled posts which have been vacant for three years.

Mr. Ramberg will report directly to the U. S. Ambassador in Rome and will advise him on scientific problems. Similar posts will be filled in: London, by Thomas Osgood, Michigan State University; Paris, by Edgar Piret, University of Minnesota, and by a deputy, Edward Cox, Swarthmore College; Bonn, by L. F. Audrieth, University of Illinois; Stockholm, by Julian Mack, University of Wisconsin; and Tokyo, by W. R. Boss, Syracuse University. All appointments are for two years.

The principal tasks of the attachés will be: To evaluate the interaction of science with foreign policy; to assess current scientific progress; to improve liaison between U. S. and foreign scientists and engineers. Co-ordination of foreign science programs operated independently by a number of government agencies will be another of their functions.

Mr. Brode, who has been working hard to reactivate the science attaché program, says, "These appointments have been eagerly awaited at home and abroad. There are 24 countries which have a science attaché in their Washington embassies; this attests to the need and usefulness for representation of science in international affairs."

The program has been dormant for three years since it is difficult to find qualified scientists who are willing to serve. Delays also occur in arranging security clearance and much time is spent in arranging leaves of absence and finding substitutes for the scientists while they are abroad.

PEOPLE

Honors and Awards. Former President Herbert Hoover, Hon. Mem. ASME, received a gold medal and citation from the National Institute of Social Science for "distinguished service to humanity."

Rear Admiral Hyman G. Rickover, 1955 ASME George Westinghouse Gold Medalist, received the Michael I. Pupin 100th Anniversary Medal from the Columbia University Engineering School Alumni Association.

Eugene W. Jacobson, Mem. ASME, was cited by The American Petroleum Institute for service as secretary and member of the ASME-API Committee on Volumeter Research, and numerous other services.

William H. McAdams, Mem. ASME, 1955 Worcester Reed Warner Medalist, emeritus professor of chemical engineering, Massachusetts Institute of Technology, received the gold medal of the French Institute of Fuels and Energy for distinguished achievement in the utilization of fuels and thermal energy.

Richard C. Jordan, Mem. ASME, and Benjamin H. Spurlock, Jr., Mem. ASME, have been promoted to the grade of Fellow ASHAE.

Albert Hansen, Jr., Mem. ASME, has been made a Fellow of AIEE.

John de S. Coutinho, Mem. ASME, received the U. S. Navy's "Murphy Award" for his presentation of a paper at the Second Navy-Aircraft Industry Conference on Aeronautical Material Reliability.

Phyllis Gaylord, senior student in the Engineering School of the University of California at Los Angeles, is the recipient of a "Lillian Moller Gilbreth Scholarship" presented by the Society of Women Engineers.

New Officers. Louis F. Polk, a director and Mem. ASME, vice-president and group executive of the Bendix Aviation Corporation, and president of the Sheffield Corporation, Dayton, Ohio, was elected president of the American Ordnance Association.

Francis K. McCune, Mem. ASME, has been elected president of The Atomic Industrial Forum.

Arthur J. Hess, president, Hess-Greiner & Polland, Los Angeles, Calif., has been elected president of the American Society of Heating and Air-Conditioning Engineers. Nominees for a three-year term on the Council of the society include: Harold A. Lockhart, Mem. ASME, and Rolland S. Stover, Mem. ASME.

Leslie S. Wilcoxson, Fellow ASME, has been elected to a three-year term as executive committee vice-chairman of The Engineering Foundation-Welding Research Council.

John Chipman, professor of metallurgy, Massachusetts Institute of Technology, has been elected president of The Metallurgical Society of AIME.

Andrew Fletcher, president, St. Joseph Lead Company, is the new president of United Engineering Trustees, Inc.

Richard G. Folsom, Fellow ASME, J. M. Juran, Fellow ASME, and Thomas H. Chilton, Mem. ASME, were recently appointed to the Engineers Joint Council Committee on Engineering Sciences.

J. R. Townsend, special assistant, Office of Assistant Secretary of Defense (Research and Engineering), has been elected president of the American Standards Association.

Ernst Weber, president, Polytechnic Institute of Brooklyn, and president, Polytechnic Research and Development Corporation, has been elected president of Radio Engineers.

Donald M. Katz, Mem. ASME,

In photos, *top to bottom:*

W. T. Cavanaugh, *center,* is the new executive director, secretary, and treasurer of the National Office Management Association, Willow Grove, Pa. He was formerly executive secretary, Engineering Manpower Commission-EJC. Shown with him are EJC president, Enoch R. Needles, *left,* and G. E. Arnold, *right,* chairman, Engineering Manpower Commission-EJC.

Colin Carmichael, Mem. ASME, *left,* incoming president of the Society of Business Magazine Editors, is congratulated by Charles O. Herb, Mem. ASME, outgoing president. The Society of Business Magazine Editors, with headquarters in Washington, D. C., is a professional society dedicated to promote high editorial standards in the business press.

Robert Fisher Oxnam, *left,* is formally installed as president of Pratt Institute by Richardson Pratt, chairman, trustees of the Institute

A team of Japanese metal-products experts touring the U. S. for a firsthand look at American industry. Bradford J. Johnson, Mem. ASME, of the State Department's International Co-operation Administration, sponsors of the program, accompanied Shizuo Nakamura, *right center,* and Yasuyuki Kimura, on a visit to Topp Industries, Inc., Los Angeles, Calif. They watch as F. T. John, *upper left,* and Frank Squires, *lower left,* explain the Micro-Path Control System, a new automation system developed by the firm.

University of Michigan, has been elected president of AIChE.

Harold A. Mosher, Mem. ASME, has been nominated for the office of president of the National Society of Professional Engineers.

Leonard Raymond, Mem. ASME, is the 1959 president of SAE.

James R. Bright, Mem. ASME, is the 1959 chairman of the College-Industry Committee on Material Handling Education of The Material Handling Institute, Inc.

Campus Data. Robert E. Burroughs has been named director of The University of Michigan Research Institute, formerly Engineering Research Institute.

Rogers B. Finch, Mem. ASME, has been made associate dean of the School of Science at Rensselaer Polytechnic Institute.

Hans Ernst, Fellow ASME, has been appointed Herman Schneider research professor in the College of Engineering, University of Cincinnati. Warren F. Stubbins has been appointed the first associate professor of nuclear science in the Graduate School of Arts and Sciences at the University of Cincinnati.

Oscar C. Maier, Mem. ASME, has been named associate dean of the School of Engineering at the University of Massachusetts.

Rufus Oldenburger, Mem. ASME, professor of mechanical engineering, Purdue University, and president, American Automatic Control Council, has been elected corresponding member of the Swiss Association of Automatic Control.

Retirement. Roy L. Parsell, Mem. ASME, has retired as head of the patent department, Winchester Operation, Olin Mathieson Chemical Corporation. Mr. Parsell will enter private practice specializing in invention, patent, trademark and copyright services, and management.

New Appointments. James B. Fisk, executive vice-president, Bell Telephone Laboratories, has been elected president of the company. He succeeds Mervin J. Kelly who was elected chairman of the board of directors.

Preliminary Announcement on Fourth U. S. Congress of Applied Mechanics, 1962

The fourth U. S. National Congress of Applied Mechanics will be held on the Berkeley campus of the University of California during June 18–21, 1962. The co-operating societies and other interested organizations are urged not to schedule conflicting meetings on these dates.

Research workers in theoretical and applied mechanics of solids and fluids are invited to submit papers for consideration by the Editorial Committee. Further announcements concerning the preparation of papers and deadlines for submission will be made as the Congress draws nearer.

The members of the organizing committee on the Berkeley campus are: Prof. W. Goldsmith, Secretary; Prof. E. V. Laitone, Treasurer; Prof. R. M. Rosenberg, Chairman of the Editorial Committee; and Prof. W. W. Soroka, General Chairman.

Inquiries regarding the Congress should be addressed to Prof. W. Goldsmith, Secretary, Division of Mechanics and Design, University of California, Berkeley 4, Calif.

EDUCATION

New Curriculum

Regents of the University of Michigan have approved two-year programs of graduate study in engineering which will permit a broader subject-area training than is now required for an MS degree. Degrees will include aeronautical engineer, civil engineer, chemical engineer, mechanical engineer, nuclear engineer, applied-mechanics engineer, and marine engineer. Programs to be given by the School of Graduate Studies will require 30 credit hours of work beyond the MS in Engineering level or its equivalent to be taken at the University of Michigan with a grade average of B or better.

Fellowships and Scholarships

The annual search for outstanding students to receive Daniel and Florence Guggenheim Fellowships for graduate study in astronautics, rockets, jet propulsion, and flight structures continues.

Eighteen to 20 fellowships will be given for study during 1959-1960 at the Daniel and Florence Guggenheim Jet Propulsion Centers at Princeton University and California Institute of Technology, and the Daniel and Florence Guggenheim Institute of Flight Structures at Columbia University. The fellowships, of which six to eight are awarded for advanced study at each Center and the Institute, provide tuition, and a stipend ranging from $1500 to $2000, depending on the stage of advancement of the student.

Applicants must file their credentials with the university selected by March 1, 1959.

Aid to Universities

• A new program of assistance to colleges and universities for education and training in radioisotope principles and technology has been announced by the U. S. Atomic Energy Commission. The purpose of the program which is one phase of a Commission effort to foster widespread use of radioisotopes, is to increase the number of scientists, engineers, and technicians qualified to contribute to and support the growing industrial use of radioisotopes and nuclear radiation. The new program provides for direct financial assistance to colleges and universities in obtaining demonstration apparatus, student laboratory equipment, and training aids needed to offer adequate laboratory course work in radioisotope technology. Apparatus and equipment available under the program include: Ionization chambers, Geiger-Müller counters, and the like.

Requirements for submission of proposals for equipment grants under this program and the criteria used in evaluating proposals may be obtained from the Director, Office of Isotopes Development, U. S. Atomic Energy Commission, Washington 25, D. C.

• The AEC has also announced approval of grants totaling $2,264,965 to 41 universities and colleges for the purchase of laboratory equipment needed to expand their nuclear educational programs in the physical sciences and engineering. These grants are part of the Commission's program to assist in providing trained manpower for the atomic-energy field.

These awards mark the fifth in a series of grants under this program and bring to $10,929,674 the total that has been allotted to 106 U. S. educational institutions.

Short Courses

• Greater concentration on writing problems and more group participation will be the features of the Seventh Annual Technical Writers' Institute to be con-

ducted at Rensselaer Polytechnic Institute, Troy, N. Y., from June 8–12. The week-long Institute, directed by Prof. Jay R. Gould, will be staffed by Rensselaer's technical writing staff, augmented by special speakers from industry and government.

The 1959 session will feature instruction on report writing, manual and instruction book writing, technical sales writing, article writing, government writing, supervision of company magazines, and illustration.

Inquiries about Writers' Institute should be sent to Jay R. Gould, Director, Technical Writers' Institute, Rensselaer Polytechnic Institute, Troy, N. Y.

• A SERIES of three short courses dealing with automatic control and process control theory will be offered this summer to practising engineers and college teachers by the mechanical-engineering department at Case Institute of Technology. The three courses will vary in length from four days to three weeks. Additional information on short courses may be obtained from Dr. James R. Hooper, Director of Special Programs, Case Institute of Technology, Cleveland 6, Ohio.

Photo-drawing, a technique of combining photographs with engineering drawings, is discussed by two actors in the Kodak movie "Photo-Reproduction." Photo-drawings may be used to facilitate production-line assembly of complicated machinery, simplify installation of wiring and piping.

Student Engineers Show

The Duke University College of Engineering will conduct its 27th Annual Engineers Show, "Engineering in Action," on March 20–21, 1959.

The show, which will feature student projects, demonstrations, and exhibits in every aspect of modern engineering science, will attract visitors from all over the southeastern United States. Last year the exposition drew more than 9000 guests to the Duke campus during its two-day span, making it the largest local attraction during the spring semester.

INDUSTRIAL FILMS

NS Savannah

"FULL Speed Ahead," 15-min film in 35-mm Eastman Color, shows construction progress on the *NS Savannah*, the world's first nuclear-powered merchant ship. Scenes include the actual setting up of a nuclear reactor power system and the elaborate precautions taken to insure its safe use in world trade.

For information on prints, write to the Maritime Administration or the U. S. Atomic Energy Commission, Washington 25, D. C.

Photo-Reproduction

"PHOTO-REPRODUCTION," 23-min color film, explains new short cuts, savings, and standards of legibility in industrial drafting operations. The movie illustrates how organizations can boost efficiency and cut drafting costs.

The movie describes the use of intermediates as "second originals," from which shop and field prints are runoff in desired quantities; use of photo-drafting techniques to cut drawing revision time to a minimum; the photo-drawing technique, which can put a combined photograph and assembly diagram at every work bench, expedite handling of piping, wiring, and various construction operations.

Information available from the Graphic Reproduction Division, Eastman Kodak Company, Rochester 4, N. Y.

Corrosion

THIS film, 16-mm, color, 19-min, tells what causes anodes and cathodes to form on steel surfaces, how they produce electrolytic corrosion, what can be done about it. Inhibitors, alloys, hot-dip galvanizing, cathodic protection, metallizing, organic coatings, and Dimetcote inorganic zinc coating are covered. Case histories show how corrosion problems are solved in various industries. For showing, write Amercoat Corporation, 4809 Firestone Blvd., South Gate, Calif.

Heliarc Welding

"INTRODUCTION to manual heliarc welding" is an 8-min, sound and color, 16-mm, motion picture. The beginner is given an orientation in Heliarc welding—how it works and what it can do. The movie shows the basic pieces of equipment and their relationship to each other, how to make a simple weld, and the excellent results that can be expected after practice. This film is available at no charge from any office of the Linde Company, Division of Union Carbide Corporation, as are other movies on Heliarc welding and other Linde electric welding processes.

LITERATURE

OGP Engine Costs

"1957 Report on Oil and Gas Engine Power Costs" includes data from 1956 and previous years. Operating-cost data

Members Vote Approval of ASHAE-ASRE Merger

Members of the two Societies have voted for the merger of the American Society of Heating and Air-Conditioning Engineers and the American Society of Refrigerating Engineers.

This was announced by ASHAE President E. R. Queer, University Park, Pa., and ASRE President Cecil Boling, W. Hartford, Conn., in a joint statement following completion of balloting, Dec. 1, 1958, at a Special Meeting of ASHAE in Chicago, Ill., and at the ASRE Semi-Annual Meeting in New Orleans, La.

The consolidated Society will be named the American Society of Heating, Refrigerating and Air - Conditioning Engineers (ASHRAE)

Each Society recorded a high total number of ballots with 93 per cent of ASHAE and 73 per cent of ASRE voting for the merger. The ASHAE ballots totaled 5712 with 5307 favoring and 405 opposing the merger. The ASRE members voted 3516 for and 1293 against the merger with a total of 4809 ballots.

According to Queer and Boling, a two-third majority of the total vote was required to approve the merger, and this expression by the members of the two societies followed a long period of exploration, explanation, and discussion.

Anticipated date of merger is Feb. 1, 1959. For the present both societies will maintain their existing headquarters which will be combined when the engineering societies move to the new United Engineering Center.

from 104 plants are contained in the 39-page report. The Subcommittee on Oil and Gas Engine Power Costs, Oil and Gas Power Division, The American Society of Mechanical Engineers, prepares the report annually.

Information on performance and production cost of oil and gas-engine power plants is presented. Data are included from 104 oil and gas-engine generating plants containing 438 engines, totaling 573,725 rated bhp. The total net output from these plants amounted to 1,028,689,888 kwhr.

Copies cost $3 (20 per cent discount to ASME members), and may be obtained by writing to: ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Diaphragm Characteristics

"Diaphragm Characteristics, Design, and Terminology," by Floyd B. Newell, Taylor Instrument Companies, Rochester, N. Y., is a convenient reference. The 74-page, paper-bound book standardizes terminology and describes diaphragm characteristics and limitations.

Published by The American Society of Mechanical Engineers, the book costs $3.75, and may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

AEC Reports

"Atomic Energy Commission Research Reports," the most recent cumulative price list of unclassified AEC research reports has recently been issued. The 64-page list is subdivided according to subjects and gives pertinent bibliographic information, cost, and AEC order number. The list may be obtained from the Office of Technical Service, U. S. Department of Commerce, Washington 25, D. C.

Creativity

"Company Climate and Creativity" explores the impact of the business and industrial environment upon the creativeness of the technical men who work within it. More than a hundred authorities on the subject of creativity have contributed their ideas and opinions to this study.

Prepared by Deutsch and Shea, Inc., technical manpower consultants, the book is published by Industrial Relations News, 230 West 41st Street, New York 36, N. Y. Cost of the study is $10 per copy.

Metal Cutting

"Proceedings of the Exploratory Clinic on New Instrumentation Requirements for Metal cutting" are available. Sessions at the clinic included discussion of what new instrumentation must do for industry, fundamentals of metal cutting—a source for new instrumentation, and metal cutting as seen by instrument people.

Published by The Foundation for Instrumentation Education and Research Inc. (FIER), the 116-page, paper-bound book costs $5. It may be obtained from FIER, 335 East 45th Street, New York 17, N. Y.

Engineering Manual

"Engineering Manual: A Practical Reference of Data and Methods In Architectural, Chemical, Civil, Electrical, Mechanical, and Nuclear Engineering" has been prepared by a staff of specialists. Edited by John H. Perry and Robert H. Perry, the 680-page book with 267 illustrations is published by the McGraw-Hill Book Company. Further details are available through McGraw-Hill's Book Information Service, 327 West 41st Street, New York 36, N. Y.

ASTM Replaces API Viscosity Standard Program

The American Petroleum Institute discontinued its three viscosity standards, Alpha, Beta, and Gamma on Jan. 1, 1959. The API program for furnishing viscosity standards, which started in 1924, will be replaced by a program under the sponsorship of the American Society for Testing Materials, Philadelphia, Pa.

The ASTM has completed arrangements with the Cannon Instrument Company, State College, Pa., for the furnishing of seven new oil standards for viscometer calibration, and the 1958 versions of ASTM tentative method D 445, Kinematic Viscosity, and standard method D 88, Saybolt Viscosity, will refer to the new series of viscosity standards.

The new standards are available from Cannon Instrument Company at a price of $15 per pint, f.o.b. State College, Pa.

Approximate viscosities are as follows

	Kinematic Viscosity, Centistokes				
Viscosity Oil Standard	At −65 F	At −40 F	At 100 F	At 122 F	At 210 F
S 3	340	86	3		
S 6			6		
S 20			20		
S 60			60		
S 200			200		
S 600			600	280	32
S 2000			2000		

	Saybolt Viscosity, Seconds		
	Universal		Furol
Viscosity Oil Standard	At 100 F	At 210 F	At 122 F
S 3	36		
S 6	46		
S 20	100		
S 60	290		
S 200	970		
S 600		150	135

Schedule Set for Papers for 1960 International Congress on Control in Moscow

American Automatic Control Council (A^2C^2) sets review committees and schedules for U. S. A. papers to be presented at first congress of International Federation of Automatic Control (IFAC) in Moscow in 1960

Russian hosts for the 1960 meeting have prepared an ambitious agenda for technical sessions. It covers three main areas—theory, components and measurement, and applications. Papers on automatic control theory will cover discrete and continuous data systems, systems using computing devices, optimalizing, multivariable systems, systems including a human operator, information theory, switching theory, stochastic processes, and simulators.

Papers on components and measurements will be sought covering the design and performance of transducers, amplifiers, computers, logic elements, regulators, telemetry, final control elements, characteristics of components, methods of dynamic testing, and reliability.

Each paper on application will pertain to a particular industry or type of controlled equipment. Typical examples: electrical machines, power systems, petroleum processing, chemical processing, ore refining, metal production, metal-working, transportation, materials handling, nuclear reactors, and heating and air conditioning.

U. S. A. papers may be submitted:

1 Directly to a member of the A^2C^2 review committee:

Chairman—E. M. Grabbe, The Thompson-Ramo-Wooldridge Corp., P. O. Box 45215, Airport Station, Los Angeles 45, Calif.

Automatic control theory—John Truxal, EE Dept., Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Components and measurements—John Johnston, Jr., Instrument Department, Engineering Services Division, E. I. du Pont de Nemours & Co., Inc., Louviers Building, Newark, Del.

Industry applications—D. M. Boyd, Universal Oil Products, Des Plaines, Ill.

2 Through the ASME, Instruments and Regulators Division, Chairman—D. J. Bergman, Universal Oil Products, Des Plaines, Ill., or appropriate professional divisions of other societies affiliated with A^2C^2.

3 Directly to the congress chairman, A. M. Letov, Institute of Automatics and Telemechanics, Kalanchovskaya 15 A, Moscow I-53, USSR.

Deadlines are:

March 1, 1959—Abstracts and rough drafts of outlines in the hands of the A_2C_2 Review Committee.

July 15, 1959—Completed papers delivered to A^2C^2 Review Committee.

The A^2C^2 Review Committee will review and evaluate for publication all U. S. A. papers. Papers may be presented in English. Russian hosts to the congress will handle translation into Russian and will publish Russian proceedings. A^2C^2 will arrange for publication of English proceedings.

For more information write: W. E. Vannah, Secretary-Treasurer, American Automatic Control Council, 330 W. 42nd Street, New York 36, New York.

Plans for Tenth International Congress of Applied Mechanics Announced, Stresa, Italy, Aug. 31–Sept. 7, 1960

The Tenth International Congress of Applied Mechanics will be held in the Congress Building at Stresa, Italy, from Wednesday, August 31, through Wednesday, September 7, 1960.

Fluid Mechanics and Mechanics of Solids

Apart from a number of invited general lectures, the technical sessions of the Congress will be delivered in two sections:

Section 1, Fluid dynamics (hydrodynamics and aerodynamics), and Section 2, Mechanics of solids (rigid body dynamics, vibrations, elasticity, plasticity, and theory of structures).

It should be noted that thermodynamics and computational methods as such are not included, although specific applications of computational methods to pertinent problems of one of the two sections afore-mentioned are acceptable subjects for papers to be read at the Tenth Congress.

Previous congresses have demonstrated the desirability of an adequate period of time for the presentation and discussion of individual papers. In order to allow a period of 45 minutes for each paper (30 minutes for presentation and 15 for discussion) a Program Committee will make a selection from papers submitted for presentation.

Abstracts Due

Abstracts of papers should be submitted in four copies to the Secretary of the International Committee, W. T. Koiter, Prof. Mekelweg 2, Delft, Netherlands before Jan. 1, 1960. Preferably they should not exceed two typewritten pages (double-spaced) and in no case should they exceed four pages. In order to facilitate the work of the Program Committee it is recommended that abstracts be in two of the official Congress languages (English, French, German, and Italian). Authors are urged to make their abstracts as clear as possible, since selection of papers has to be based upon them. Decisions of the Program Committee are final, and it will be understood that it is impossible to enter into correspondence about them with authors of papers. They will be informed promptly of the decision on each paper.

Day-to-day organization of the Congress is effected by the Italian Organizing Committee (President: Prof. G. Colonnetti; secretary: Dr. F. Rolla, Consiglio Nazionale delle Ricerche, Ufficio relazioni internazionali, Piazza delle Scienza 7, Roma). All correspondence (apart from submission of papers) should be addressed to the Italian Organizing Committee. Information on accommodation, also registration forms, will be obtainable from Dr. Rolla on and after Sept. 1, 1959.

1959 NUCLEAR CONGRESS

Co-ordinated by EJC; sponsored by ASME with 26 other Organizations, April 5–10, 1959, Cleveland, Ohio

- *5th Nuclear Engineering and Science Conference*
- *7th Hot Laboratories and Equipment Conference*
- *7th Atomic Energy in Industry Conference*
- *Atomfair*

DETAILS of the 1959 Nuclear Congress, the nation's largest gathering of specialists in the atomic field, were announced recently. Forty sessions are to be held during the five-day congress which begins April 5, at the Public Auditorium in Cleveland, Ohio.

Features of the meeting will be engineering papers dealing with advances in reactor technology and the use of radioactive materials; a trade show, the Atomfair; talks devoted to problems of industrial management in the nuclear field; and papers devoted to laboratory problems in radioactive materials.

The announcement noted that invitations had been issued to Russian engineers to describe details of their power-reactor program, including a 600,000-kw power plant reported to be under construction in Siberia.

Featured at the Congress will be luncheon addresses by outstanding authorities in the nuclear field and an "All-Congress" banquet on Wednesday evening, April 8, 1959. Among the speakers will be Dr. Arthur Compton, Chancellor, Washington University of St. Louis, and Nobel Prize winner in Physics; and Dr. Miles Leverett, Director of the Nuclear Propulsion Laboratories of the General Electric Company. Other speakers include specialists from England, France, and Italy.

Theme of the congress, which will be sponsored by more than thirty leading engineering, scientific, and management groups, is "For Mankind's Progress."

Tentative Program

Nuclear Engineering and Science Conference, April 5–10

▶ MONDAY, APRIL 6

Waste Disposal 9:30 a.m.

Evaluation of the Initial Performance of the Shippingport Radioactive Waste-Disposal Plant, by *J. R. Lapointe, W. J. Hahn,* and *E. D. Harward,* Westinghouse Elec. Corp. (Paper No. V-1)

Development of Design Principle for Disposal of Reactor Fuel Waste Into Underground Salt Cavity, by *Shosei Serata* and *E. F. Gloyna,* Univ. of Texas (Paper No. V-2)

Proportional Sampling of Flowing Liquid Wastes for Radioactivity Monitoring, by *J. M. Ruddy,* Brookhaven Natl. Lab. (Paper No. V-3)

Thermal Considerations in the Storage of Radioactive Wastes in Salt Formation, by *R. S. Schechter* and *E. F. Gloyna,* Univ. of Texas (Paper No. V-4)

Disposal of Radioactive Liquids From Nuclear Powered Ships, by *J. M. Smith, Jr.,* Gen. Elec. Co., San Jose, Calif. *

The Need for Biological Monitoring of Radioactive Waste Streams, by *R. F. Foster,* Gen. Elec.—Hanford Labs. *

Nuclear Research Test and Training Facilities 9:30 a.m.

Radiological Health Training for Personnel Responsible for Water Quality, by *D. W. Moeller, D. A. Pecsok,* and *H. P. Kramer,* Robert A. Taft Sanitary Engineering Center (Paper No. V-7)

The University of Florida Training Reactor, by *J. M. Duncan,* Univ. of Florida (Paper No. V-10)

The Army Training Program for Nuclear Power-Plant Personnel, by *Lieut. W. Eager, Capt. D. King,* and *Capt. J. LaFleur* (Paper No. V-11)

Simulation and Experimental Instrumentation 9:30 a.m.

Instrumentation for the Reactor Transient Study Program of the KEWB Reactor, by *E. L. Gardner, J. W. Flora, Lieut. R. K. Stitt,* and *R. E. Wimmer,* Atomics International *

Critical Experiment-Safety Systems With Electrometer-Type Operational Amplifiers, by *Russell Ball,* The Babcock & Wilcox Co. *

Simulation of the EBWR for the Geneva Conference, by *R. A. Brey,* Leeds & Northrop Co. *

Transistorized Computers for Naval Reactor Nuclear Instrumentation Systems, by *Warren Alexander,* Stromberg-Carlson Co. *

Approximate Solutions to the Reactor Kinetic Equations for Ramp Inputs, by *John MacPhee,* AMF Atomics (Paper No. V-17)

A Low-Cost Nuclear Power-Plant Simulator, by *C. C. Scott,* Minneapolis-Honeywell Regulator Co. (Paper No. V-18)

Water Supply 2:15 p.m.

Some Considerations in the Development of Emergency Procedures in Case of an Accidental Release of Liquid Radioactive Wastes From a Nuclear Reactor, by *E. D. Harward,* AEC-Pittsburgh Naval Reactor Operations Office (Paper No. V-19)

The Measurement, Building Penetration, and Water-Filter Passage of Radioactivity, by *C. G. Bell, Jr.,* Oak Ridge Natl. Lab. *

Concepts in Determining the Potability of Water Following a Nuclear Attack, by *Gerhard Klein,* Univ. of California (Paper No. V-122)

Assembly and Operation of Low-Level Counting Facility, by *G. R. Hagee,* Robert A. Taft Sanitary Engineering Center (Paper No. V-21)

Radioactivity in Water—Environmental Surveillance, by *H. P. Kramer, D. W. Moeller,* and *D. A. Pecsok,* Robert A. Taft Sanitary Engineering Center (Paper No. V-22)

Nuclear Instruments 2:15 p.m.

Design and Development of a 600 F. Pulse Pre-Amplifier for Nuclear Instrumentation, by *W. L. Frisby* and *E. M. Palmer,* Gen. Elec. Co., Burlington, Vt. *

A Dual-Channel Reactor Protection System for Nuclear Power Plants, by *A. S. Bartu,* Gen. Elec. Co., San Jose, Calif. (Paper No. V-24)

Analysis of Response of a High-Impedance Nuclear Reactor Power-Indicator Channel, by *R. J. Allen,* Atomics International (Paper No. V-25)

Circuits in the MTR Pulse Analyzers, by *Frank Petree,* Phillips Petroleum Co. *

Halogen-Tube Remote-Area Monitoring System, by *H. A. Brown* and *J. V. Rogers,* Tracerlab, Inc. (Paper No. V-27)

Reactor-Component Design 2:15 p.m.

Stress Analysis of the Junction Between a Support Skirt and Pressure Vessel, by *R. F. Wojciesak,* Gen. Elec. Co., Schenectady, N. Y. *

Cold Traps, Freeze Jackets, and Refrigeration System Used in the HRT, by *R. C. Robertson,* Oak Ridge Natl. Lab. *

Stresses in Hollow Cylinders Due to Asymmetrical Heat Generation, by *H. Kraus* and *G. Sonnemann,* Westinghouse Elec. Corp. (Paper No. V-31)

Some Aspects of Safeguarding High-Pressure Equipment in Nuclear Technology, by *R. H. Scott,* Gen. Elec.—Hanford Labs. *

▶ TUESDAY, APRIL 7

Health Physics 9:00 a.m.

Radiation and Contamination Control at the Hanford Reactors, by *S. L. Nelson,* Gen. Elec.—Hanford Labs. (Paper No. V-33)

Alteration of a Gamma Cell for Plutonium—Gamma Usage, by *H. M. Glen,* Oak Ridge Natl. Lab. (Paper No. V-34)

Bases for Establishing Nuclear Safety Criteria, by *Norman Ketzlach,* Gen. Elec.—Hanford Labs. (Paper No. V-35)

A History of Occupational Exposures to Uranium-Air Contamination in Feed-Materials-Production Facilities, by *A. J. Breslin* and *W. B. Harris,* AEC—Health and Safety Labs. *

The Validity of Film Badge and Pocket-Chamber Records in Evaluating the Radiation Exposure of Personnel, by *Hanson Blatz,* Industrial Medicine, New York Univ. *

Contributions to Gonadal Dose by Medical and Dental X-Rays, by *J. S. Laughlin* and others, Sloan-Kettering Memorial Inst. *

Heat Transfer 9:00 a.m.

Thermal Contact Conductance of Unbonded Metal to Metal and Metal to Ceramic Joints, by *R. G. Wheeler,* Gen. Elec.—Hanford Labs *

Determination of Local Heat-Transfer Coefficients by a Transient Technique, by *B. A. Stanley* and *J. B. Conway,* Gen. Elec. Co., Evendale, Ohio (Paper No. V-40)

Surface-Temperature Measurement of Internally Heated Plates, by *J. A. Robinson* and *J. B. Conway,* Gen. Elec. Co., Evendale, Ohio *

Heat Transfer to Non-Newtonian Fluids, by *E. H. Wissler* and *R. S. Schechter,* Univ. of Texas (Paper No. V-41)

Design-Selection Technique Applied to Astro-Heat Exchange, by *J. R. Boyd,* Lockheed Aircraft Corp. *

Reactor Instrumentation 9:00 a.m.

An invited paper, by *J. Haarer* *

A Transistorized Power-Reactor Safety System, by *H. H. Hendon* *

A Digital Startup Control for Air-Cooled Nuclear Reactors, by *S. N. Lehr,* Gen. Elec. Co., Cincinnati, Ohio *

Magnetic Automatic Power-Range Control for an Aircraft Nuclear Reactor, by *S. F. Hemmenway, J. A. Russell, J. L. Schaff,* and *P. C. Sharr,* Gen. Elec. Co., Cincinnati, Ohio *

Electrical Control-System Components for Starting Aircraft-Propulsion Reactors, by *R. H. Willsey, P. K. Hiser, M. E. Ward,* and *A. D. Wilcox,* Gen. Elec. Co., Cincinnati, Ohio *

Chemistry and Chemical Processing 2:15 p.m.

Development Studies on the Solidification of Radioactive Waste by Fluid Bed Calcination, by

* Paper not available.

J. W. Loeding, E. L. Carls, and *A. A. Jonke,* Argonne Natl. Lab. *

Radiochemical Reprocessing Costs in an Expanding Nuclear Economy, by *C. E. Guthrie,* Oak Ridge Natl. Lab. *

Review of Developments in Reprocessing of Irradiated Nuclear Fuels by Pyrometallurgical Methods, by *L. F. Coleman, J. H. Schraidt,* and *G. I. Bernstein,* Argonne Natl. Lab. (Paper No. V-50)

Recent Developments in Feed Preparations and Solvent Extraction, by *R. R. Bruce, R. E. Blanko,* and *J. C. Bresee,* Oak Ridge Natl. Lab. *

Production of Pure Uranium Hexafluoride From Ore Concentrates, by *W. C. Ruch, D. A. Peterson, E. A. Gaskill,* and *H. G. Tepp,* Allied Chemical and Dye Corp. *

Investigation of Chemical Methods for Nuclear Reactor Decontamination, by *J. L. Zegger* and *G. P. Pancer,* Alco Products Inc. *

Power-Reactor Design 2:15 p.m.

The Design of Daniels-Boyd Nuclear Steam Generator for a 400-emw Net Power Plant, by *W. Boyd J. A. Paget,* and *P. Hamel,* Engineering Inst. (Paper No. V-54)

Evolution of the Army Package-Power-Reactor Family, by *J. G. Gallagher,* Alco Products Inc.

Design of a 10-emw Net Sodium-Deuterium Reactor Power Plant, by *E. D. Oppenheimer, J. G. Duffy,* and *C. Graves,* Nuclear Development Corp. of America *

The Potential of Organic Cooled, Heavy-Water Reactors for Economic Power Generation, by *M. J. McNelly,* Canadian Gen. Elec. Co. Ltd. (Paper No. V-57)

Instrumentation 2:15 p.m.

Effects of Reactor Exposure on Boron-Lined and BF_3 Proportional Counters, by *W. M. Trenholme,* Gen. Elec. Co., Lynn, Mass. (Paper No. V-58)

A System Design for Improved Water-Level Control of Steam Generators, by *D. P. Waite,* Gen. Elec. Co., Lynn, Mass. (Paper No. V-59)

A Differential Pressure Instrument for High-Temperature Service, by *S. A. Hluchan,* Taylor Instrument Co. (Paper No. V-60)

Clamp-on Resistance-Temperature Detectors for Reactor Use, by *R. G. Clark* *

Nuclear Power Plants Acceptance Testing, by *W. H. Hamilton* and *G. H. Conley,* Westinghouse Elec. Corp. *

▶ WEDNESDAY, APRIL 8

Nuclear-Fuel Processing Plants—Design and Practice 9:00 a.m.

Design Versus Performance of Process and Equipment in a Large-Scale Radiochemical-Separations Plant, by *A. W. Joyce, E. B. Sheldon,* and *L. C. Perry,* E. I. du Pont de Nemours & Co., Inc. (Paper No. V-71)

Design and Operating Considerations for Off-Gas Systems in Nuclear Processing Plants, by *L. R. Michels,* Gen. Elec.—Hanford Labs. (Paper No. V-72)

An Evaluation of the Design and Performance of the Thorex Plant, by *G. S. Sadowski* and *W. R. Winsbro,* Oak Ridge Natl. Lab. (Paper No. V-73)

Comparison of Design and Operating Performance at the Idaho Chemical-Processing Plant, by *A. L. Ayers* and *F. M. Warzel,* Phillips Petroleum Co. (Paper No. V-74)

Radio Tracers in the Process Industries 9:00 a.m.

Measurement of Gear Wear by Activating Wear Particles in the Lubricant, by *H. D. Briggs,* Gen. Elec. Co., Schenectady, N. Y. *

Radioisotope Utilization in Industrial Applications by *P. Kruger,* Nuclear Science and Engineering Corp. (Paper No. V-76)

Radiochemical Tracing of Pilot Unit Fluid-Catalyst Flow, by *A. von Rosenberg* and *R. L. Hull,* Humble Oil and Refining Co. *

An Investigation of Sodium-Phosphate Hide-Out in Boiling Water Using Phosphorus 32, by *J. W. Stout, Jr.,* Baltimore Gas and Elec. Co. *

A Radio-Tracer Study of Flow Patterns in a Fluid Coker, by *J. M. Ausman, A. Beerbower,* and *R. E. Olsen,* Esso Research and Engineering Co.*

Reactor Physics 9:00 a.m

Nuclear Analysis of Small Thermal Reflected Cylindrical Homogeneous Critical Assemblies, by *G. P. Rutledge, P. A. Kantorczyk,* and *M. R. Stuart,* Westinghouse Elec. Corp. *

Nuclear Calculation for a Continuously Fueled Pebble Bed Reactor, by *R. O. Bagley,* Alco Products Inc. (Paper No. V-81)

AEC Reactor Physics Program, by *W. C. Bartels,* AEC (Paper No. V-82)

Sodium-Graphite Reactor Stability Analysis, by *J. Reichman,* Atomics International *

Neutron Energy Spectrum Calculations in Reactor Shields, by *J. W. Haffner,* Gen. Elec. Co., Evendale, Ohio (Paper No. V-84)

Fuel Technology 2:15 p.m.

Fabrication of BR-2 Fuel Elements, by *A. Strasser,* Nuclear Development Corp. of America*

Nondestructive Clad-Thickness Measurement of Uranium-Oxide Fuel Pins, by *R. M. Ball,* The Babcock & Wilcox Co. (Paper No. V-86)

The Fabrication of Tubular Fuel Elements, by *S. Megeff* and *J. L. Zambrow,* Sylvania-Corning Nuclear Corp. *

UO_2 Ceramic Fuel, by *R. M. Powers,* Sylvania-Corning Nuclear Corp. *

Rate of Alloying of SRE Metal Fuels With Stainless Steel Above 1500 F, by *R. S. Neymark,* Atomics International *

Irradiation of Fuel-Elements Containing UO_2 Powder, by *J. L. Bates,* Gen. Elec.—Hanford Labs. (Paper No. V-90)

Isotope Application 2:15 p.m.

Measurement and Control of Plastic Film Thickness Using Beta-Ray Gages, by *G. C. Wiggins,* Dow Chemical Co. (Paper No. V-91)

Control of Fat Centrifuge by Gamma-Ray Measurement, by *F. Brown,* George A. Hormel and Co. *

Process Applications of Radio Isotopes in a Chemical Company, by *R. A. Mulcahy* and *C. B. Moore,* E. I. du Pont de Nemours & Co., Inc. *

Operating Experience With Instruments Using Radio Isotopes in the Process Industries, by *R. C. Kimball,* American Viscose Corp. *

Measurement of Liquid Density Using a Beta-Ray Source, by *E. J. Frek* and *Charles Kearns,* Industrial Nucleonics Corp. *

Continuous Analysis by X-Ray Absorption, by *A. Beerbower,* Esso Research and Engineering Co. *

European Power Reactor—A 2:15 p.m.

The Hunterston Project and the Future Development of the Gas-Cooled Power Reactor, by *K. J. Wootton,* Kent, England *

The Berkeley Power Station and Its Influence on Future Developments, by *A. L. Shaw,* John Thompson Nuclear Energy Co., Ltd., Knutsford, England (Paper No. V-64)

Multipurpose Reactor for Spain, by *R. K. Winkleblack,* Atomics International *

The Status of Nuclear Power in Italy, by *Felice Ippolito,* Rome, Italy *

▶ THURSDAY, APRIL 9

European Power Reactor—B 9:00 a.m.

Marcoule's Reactors G.2 and G.3—Some Features

Core, Shielding, and Pressure Vessels, Part 1, by Société des Forges et Ateliers du Creusot, Compagnie Industrielle des Travaux, and Coyne et Bellier *

Load Refueling, Part 2, by Société Alsacienne de Constructions Mécaniques *

Reactor Cooling—Gas and Vapor Circuits, Part 3 by Société Rateau and Chantiers de l'Atlantique*

Station Control, Part 4, by Alsthom *

Fusion Processes 9:00 a.m.

The Present Status of Thermonuclear Research, by *A. E. Ruark* *

Problems of Fusion, by *J. L. Tuck* *

A Survey of Fusion Processes, by *R. F. Post* *

The Design and Operation of a Shunt-Regulated 25,000 Joule Inductive Energy-Storage System, by *R. L. Gamblin,* James Forrestal Research Center (Paper No. V-100)

Metallurgy and Materials—A 9:00 a.m.

The Fabrication of Tubular Uranium-Fuel Elements, by *C. E. Polson, H. Davis, J. F. MacNeill, J. F. Schilts,* and *J. Magoun,* National Lead Co.*

Fabrication of Graphite Urania Fuel for a Transient Reactor Test, by *J. H. Handwerk, F. D. McCuaig,* and *C. H. Bean,* Argonne Natl. Lab. *

* Paper not available.

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Will leave on........ at ....a.m. p.m.

My wife............attend the Congress.
will, will not

I will share accommodations with.......
....
....

Tensile Creep of Pure and Uranium-Loaded Graphites, by *L. Green, Jr., M. L. Stehsel,* and *C. E. Waller,* Aerojet-General Corp. (Paper No. V-103)

The Use of Isostatic Pressure Techniques in the Fabrication of Fuel Elements, by *J. Fugardi* and *J. L. Zambrow,* Sylvania-Corning Nuclear Corp.*

Segregation in Aluminum-13 Per Cent Uranium Castings, by *D. Peckner,* Westinghouse Elec. Corp. (Paper No. V-105)

The Swelling of Irradiated U-Zr Alloy During Temperature Transients, by *W. V. Johnston,* Knolls Atomic Power Lab. *

The Effect of Metallic Impurities on the Properties of Uranium and 2 w/o Molybdenum-Uranium Alloys, by *J. M. Dickinson* and *E. E. Zukas,* Los Alamos Scientific Lab. *

Metallurgy and Materials—B 2:15 p.m.

Sinterability of UO Powders for Fuel Elements, by *R. B. Wrinkle,* Mallinckrodt Chemical Works*

A Diffusion Mechanism of the Initial Sintering of Refractory Materials by *R. Chang,* Atomics International *

Forge Rolling Zircaloy Components, by *R. D. Johnson,* Clevite Research Center *

Irradiation-Induced Hydrogen Absorption by Nickel-Enriched Zircaloy-2, by *W. Yeniscavich, R. A. Wolfe,* and *R. M. Lieberman,* Westinghouse Elec. Corp. *

The Use of Ultrasonics in the Testing of Irradiated Fuel Elements, by *J. M. Fouts,* Gen. Elec.—Hanford Labs. (Paper No. V-112)

The Development of Nuclear Radiation-Resistant Fluids and Lubricants, by *W. L. R. Rice* and *Lieut. D. A. Kirk,* Wright Air Development Center (Paper No. V-113)

Sodium Corrosion as a Function of Time, by *J. M. McKee,* Nuclear Development Corp. of America

Purification of Lithium by Vacuum Distillation, by *W. Arbiter* and *S. Lazerus,* Nuclear Development Corp. of America *

Reactor-Operating Experience and Maintenance 2:15 p.m.

Operational Problems of the Original Hanford Reactors, by *J. R. Young,* Gen. Elec.—Hanford Labs. (Paper No. V-117)

The Buildup of Radioactivity in the Primary System of the Army Package-Power Reactor, by *W. S. Brown,* Alco Products Inc. *

Inspection and Maintenance Experience With HRE II, by *D. M. Shepherd* and *C. W. Collins,* Oak Ridge National Lab. *

OMRE Operating Experience, by *N. J. Swanson* and *D. R. Muller,* Atomics International *

* Paper not available.

Availability of Papers

ONLY *numbered* papers listed in the program of the Fifth Nuclear Engineering and Science Conference are available in separate form. Copies may be obtained from Engineers Joint Council, 29 West 39th Street, New York 18, N. Y., at 50 cents each. Papers must be ordered by the paper numbers listed in this program, otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the Nuclear Congress.

Papers of the Hot Laboratories and Equipment Conference will only be available in bound sets. These bound sets, priced at $10 per set, will not be available in advance.

European Power Reactor—C 2:15 p.m.

Four or five papers on Soviet Power Plant Technology are being negotiated.

Tentative Program

Seventh Conference on Hot Laboratories and Equipment

The following program is tentative and is subject to change. Some papers may be withdrawn; others possibly may be added. Final program will be available Feb. 1, 1959. All sessions will be consecutive; no concurrent sessions will be held. Sequence of sessions is subject to change as is sequence of papers within sessions.

Session 1. Hot Laboratories and Facilities

Georgia Nuclear Aircraft Laboratory,[1] by *R. A. Thompson, C. E. Vivian,* and *L. A. Williams,* Lockheed Nuclear Products, Lockheed Aircraft Corp., Marietta, Ga.

A Low-Cost Multicurie Radiochemical Facility, by *A. J. Moses, J. E. Hudgens, W. E. Smith, A. D. Bogard,* and *E. H. Stearns,* Westinghouse Elec. Corp., Bettis Site, Pittsburgh, Pa.

Hanford's Radiochemistry Hot Cells, by *R. W. Dascenso* and *K. H. Hammill,* Hanford Atomic Products Operation, Gen. Elec. Co., Richland, Wash.

Intermediate-Level Radiochemistry Hot Cell, by *P. F. Moore,* Los Alamos Scientific Lab., Los Alamos, N. Mex.

Design of an Industrial Radioisotope Laboratory, by *E. W. Coleman, D. T. Green,* and *L. Van Gelderen,* Picker X-Ray Corp., Cleveland, Ohio

The Design, Construction, and Equipment of the New Components Development Hot-Cell Facilities by Atomics International, by *J. M. Davis* and *B. H. Webb,* Atomics International Division, North American Aviation, Inc., Canoga Park, Calif.

Fuel-Element Examination Facility for the Plutonium-Recycle-Test Reactor, (PRTR), by *W. S. Kelly,* Hanford Atomic Products Operation, Gen. Elec. Co., Richland, Wash.

Pre-Emergency Planning in Radiochemical Facilities, by *T. W. Hungerford,* Oak Ridge Natl. Lab., Oak Ridge, Tenn. (by title only).

KAPL Hot Lab Radiation Corrosion Facility, by *W. F. Niebuhr,* Knolls Atomic Power Lab., Gen. Elec. Co., Schenectady, N. Y. (by title only).

Laboratory for Nuclear Research by a Petroleum Company, by *J. R. White, E. O. Guernsey,* and *R. W. Laferty,* Socony Mobil Oil Co., Inc., Paulsboro, N. J.

A Low-Cost 100-Curie Shield Facility, by *A. J. Gawin* and *R. A. Blomgren,* Argonne Natl. Lab., Lemont, Ill.

A Portable Hot Laboratory, by *E. Mestre, R. Rapin,* and *S. Rapin,* Commissariat a L'Energie Atomique, France

Building a Facility for the Handling of Kilocurie Amounts of Gamma Emitters, by *P. Germond,* Commissariat a L'Energie Atomique, France

Session 2. General Manipulative Equipment

Brookhaven Rectilinear Manipulator Model 4, by *L. G. Stang, Jr.,* Brookhaven Natl. Lab., Upton, N. Y.

Design Criteria for Heavy-Duty Master-Slave Manipulator, by *D. G. Jelatis,* Central Research Lab., Inc., Red Wing, Minn.

Electronic Master-Slave Manipulator ANL Model 3, by *Ray Goertz,* Argonne Natl. Lab., Lemont, Ill.

Slave-Robot Developments, by *Ray Goertz* Argonne Natl. Lab., Lemont Ill.

Mechanical Master-Slave Model 9 Manipulator by *Ray Goertz,* Argonne Natl. Lab., Lemont, Ill.

French Master Slaves, by *G. Cherel,* Commissariat, a L'Energie Atomique, France

Session 3. Viewing

Equipment for the Microscopic Observation of Radioactive Materials, by *R. L. Seidenberg,* Bausch and Lomb Optical Co., Rochester, N. Y.

Gamma-Ray Induced Electrical Discharge in a Radiation Shielding Window, by *Vaughn Culler,* Corning Glass Works, Corning, N. Y.

New Remote Viewing Scope for Hot Cells, by *J. L. Maulbetsch* and *J. J. Lerse,* Lerma Engineering Corp., Northampton, Mass.

Measurements Through a Hot-Cell Window Using Optical Tooling, by *A. A. Abbatiello,* Oak Ridge Natl. Lab., Oak Ridge, Tenn

Effects of Radiation on Surfaces of Shielding Glasses, by *Kenneth Ferguson,* Argonne Natl. Lab., Lemont, Ill.

The Pre-Lighting Installation, by *G. Gustovich,* Atomics International. Canoga Park, Calif. (by title only).

Session 4. Cell Fixtures and Specialized Manipulative Equipment

Combination Wet Cutoff Wheel and Milling Machine, by *E. C. Lusk* and *R. J. Burian,* Battelle Memorial Inst., Columbus, Ohio

Radioactive Decontamination by Ultrasonics, by *L. M. Behr* and *W. L. Bryant,* Westinghouse Elec. Corp., Bettis Plant, Pittsburgh, Pa.

The Use of Commercial Equipment for Analytical Chemistry by Remote Control, by *J. J. McCown, W. R. Sovereign,* and *R. P. Larsen,* Argonne Natl. Lab., Lemont, Ill.

Creep-Test System, by *R. F. Stearns,* Knolls Atomic Power Lab., Gen. Elec. Co., Schenectady, N. Y.

Dry-Storage Facility for Irradiated Materials, by *S. O. Lewis* and *S. E. Dismuke,* Oak Ridge Natl. Lab., Oak Ridge, Tenn.

Device for Remotely Slitting Aluminum Tubes, by *P. H. Chismar,* Savannah River Lab., E. I. du Pont de Nemours & Co., Inc., Aiken, S. C.

An Air-Driven Abrasive Cut-Off Machine for Remote Operations, by *P. H. Chismar,* Savannah River Lab., E. I. du Pont de Nemours & Co., Inc., Aiken, S. C.

Machines and Tools for Underwater Use at the West Milton Fuel Service Facility, by *B. B. Biggs,* Gen. Elec. Co., Knolls Atomic Power Lab., Schenectady, N. Y.

Storage and Handling Facilities for a Large Hospital Radium Unit, by *N. A. Baily,* Roswell Park Memorial Inst., Buffalo, N. Y. (by title only).

Magnetic Couplings for Totally Sealed Systems, by *A. Oltmann,* Brookhaven Natl. Lab., Upton, N. Y. (by title only).

A Gamma-Ray Scanner for In-Cell Use, by *D. K. Dieterly, D. N. Sunderman,* and *R. J. Burian,* Battelle Memorial Inst., Columbus, Ohio (by title only).

A Remotely Controlled Drop-Weight Test Machine for Brittle Fracture Studies, by *L. E. Steele* and *J. R. Hawthorne,* U. S. Naval Research Lab., Washington, D. C. (by title only).

Wet Cut-Off Saw, by *R. F. Stearns,* Knolls Atomic Power Lab., Gen. Elec. Co., Schenectady, N. Y. (by title only).

Spectrometer Positioning Device, by *W. A. Pate,* Oak Ridge Natl. Lab., Oak Ridge, Tenn. (by title only).

A Remotely Operated Charpy-Test Machine for Brittle Fracture Studies, by *J. R. Hawthorne* and *L. E. Steele,* U. S. Naval Research Laboratory, Washington, D. C. (by title only).

Devices for Structural Material Testings, by *J. L. Bernard, R. Marinot, P. Pesenti,* and *Ph. Wallet,* Commissariat a L'Energie Atomique, France

Session 5. Gamma Irradiation Facilities

A 90-Curie Cobalt 60 Irradiation Unit, by *A. L. Riegert* and *J. W. T. Spinks,* Univ. of Saskatchewan, Saskatoon, Canada

Progress in the Technology of Gamma Irradiation With Multikilocurie Cobalt 60 Sources for the Scientific, Industrial, and Medical Research, by *O. F. Joklik,* Transcontinental Atomic Co., Lugano, Switzerland

A Gamma Irradiation Facility Employing Eight Spent MTR Fuel Elements, by *P. J. Manno,* Continental Oil Co., Ponca City, Okla.

A 10,000-Curie Cobalt 60 Irradiation Cave,[1] by *A. Danno, M. Omura, H. Hotta, H. Hirakawa, G. Tsuchihashi,* and *I. Yamaguchi,* Japan Atomic Energy Research Inst., Tokyo, Japan

The Cobalt 60 Irradiation Facility at the Department of Mines and Technical Surveys, Ottawa, by *R. E. Carson* and *B. I. Parsons,* Department of Mines and Technical Surveys, Ottawa, Canada

A Multipurpose Agricultural Cobalt 60 Gamma Irradiator, by *H. J. Teas,* Univ. of Florida, Gainesville, Fla.

Session 6. Operations and Techniques

The Disassembly and Sampling of an Irradiated

[1] Title subject to change.

EBWR Fuel Subassembly, by *C. F. Reinke* and *L. S. Markheim*, Argonne Natl. Lab., Lemont, Ill.

Liquid Waste Disposal Methods at Bettis,[1] by *W. L. Bryant* and *L. M. Behr*, Bettis Plant, Westinghouse Elec. Corp., Pittsburgh, Pa.

Techniques, Equipment, and Methods of Operation Used at the KAPL Radioactive Materials Laboratory Remote Metallography Cell, by *B. D. Wemple*, Knolls Atomic Power Lab., Gen. Elec. Co., Schenectady, N. Y.

Designing Equipment for Underwater Facilities, by *J. K. Figenshau* and *George C. Kelly*, General Mills, Inc., Minneapolis, Minn.

Remote Fabrication of SRE-Type Fuel Rods, by *T. A. Godking, D. Janeves, M. A. Fallandy, F. E. Vonderahe*, and *K. L. Mattern*, Atomics International, Canoga Park, Calif.

In-Pile Testing of Fuel Elements, by *D. C. Kaulitz*, Gen. Elec. Co., Hanford Atomic Products Operation, Richland, Wash.

A Dynamic Corrosion Facility for Irradiated Fuel, by *K. R. Hunter*, Knolls Atomic Power Lab., Gen. Elec. Co., Schenectady, N. Y.

Heat-Treating Techniques for Irradiated Fuel Materials, by *E. D. Grassini*, Bettis Plant, Westinghouse Elec. Corp., Pittsburgh, Pa. (by title only).

Radioactive Material Handling, by *R. R. Fouse* and *A. L. Maharam*, Westinghouse Elec. Corp., Bettis Plant Pittsburgh, Pa. (by title only).

Hydrostatic Burst Test on Irradiated PWR Fuel Elements, by *J. H. Bowling*, Westinghouse Elec. Corp., Bettis Plant, Pittsburgh, Pa. (by title only).

Handling Solid Waste From Caves at the Savannah River Laboratory, by *M. R. Caverly*, Savannah River Lab., E. I. du Pont de Nemours & Co., Inc., Aiken, S. C. (by title only).

ETR Experiment and Tube Removal, by *W. F. Niebuhr*, Knolls Atomic Power Lab., Gen. Elec. Co., Schenectady, N. Y. (by title only).

High-Level Dissolution and Processing of Field Release Test 1 Samples, by *L. O. Sullivan*, Vallecitos Atomic Laboratory, Gen. Elec. Co., Pleasonton, Calif. (by title only).

Analytical Service for the Homogeneous Reactor Test, by *U. Koskela, L. G. Farrar, J. E. Attrill*, and *J. L. Mottern*, Oak Ridge Natl. Lab., Oak Ridge, Tenn. (by title only).

Session 7. Problems in Simultaneous Handling of Alpha and Gamma-Emitting Materials

Invited paper, title to be submitted later, by *W. H. Langham*, Los Alamos Scientific Lab., Los Alamos, N. Mex.

Invited paper, **Radiological Safety Problems Associated With Alpha Emitters,** by *D. D. Meyer*, Los Alamos Scientific Lab., Los Alamos, N. Mex.

Invited Paper, **Plutonium Handling Hazards,** by *T. S. Chapman*, Dow Chemical Co., Rocky Fats Plant, Denver, Colo.

Invited paper, title to be submitted later, by *J. R Lilienthal*, Los Alamos Scientific Lab., Los Alamos, N. Mex.

Alpha-Gamma Metallurgical Research Facility, by *Ray Goertz*, Argonne Nat. Lab., Lemont, Ill.

High-Level Alpha-Gamma Cell, by *S. Dismuke*, Oak Ridge Natl. Lab., Oak Ridge, Tenn.

Transfer of Solid Waste Through Alpha and Gamma Barriers, by *R. A. Blomgren*, Argonne Natl. Lab., Lemont, Ill.

Invited paper, title to be submitted later, by *L. J. Defferding*, Gen. Elec. Co., Hanford Atomic Products Operation, Richland, Wash. (by title only).

Invited paper, **Decanner for EBR-II Pins,** by *John Simon*, Argonne Natl. Lab., Lemont, Ill.

Session 8. Round-Table Discussion of Operational Problems

Panel Members:

L. D. Turner, Hanford Atomic Products Operation
W. B. Doe, Argonne National Laboratory
E. S. Schwartz, Westinghouse Test Reactor
G. J. Deily, Savannah River Laboratory
D. D. LaRocque, Knolls Atomic Power Laboratory
R. R. Fouse, Westinghouse Atomic Power Division

Panel Chairman: *R. Westphal*, Westinghouse Atomic Power Division

Atomic Energy in Industry Conference

Sponsored by: *National Industrial Conference Board*

Morning and afternoon sessions; *Wednesday, Thursday, and Friday, April 8, 9, and 10.*

The Atomic Energy in Industry Conference consists of a series of discussions on the broad application of nuclear power, and the influence and potential of the nuclear field on the sociological and economic structure of industry.

Atomfair

The Atomfair hours are from 9:00 a.m. to 5:00 p.m. from April 6 through April 10.

The Atomfair is an exhibit by major manufacturers of the latest products, components, and services for the peaceful use of atomic energy. At the Atomfair you will have an opportunity to discuss your problems and needs with top factory representatives of the leading suppliers in the nuclear industry. This exposition is being held in conjunction with the technical sessions of the Nuclear Congress at the Municipal Auditorium. Persons registering for any conference will automatically be admitted to the Atomfair.

ASME Chicago Section Hears Firsthand Report on Geneva Conference

U. S. scientific exhibit a high light

America's scientific exhibit at the Geneva Conference was one of the high lights of the international meeting; Russia reported impressive gains in reactor engineering; and the United Kingdom played a leading role in the industrial exhibit.

Amusement

This assessment of the Second United Nations Conference on the Peaceful Uses of Atomic Energy was given by Joseph M. Harrer of the Argonne National Laboratory in a talk before the Chicago Section of The American Society of Mechanical Engineers, on Wednesday, January 7.

"We outdid ourselves in the preparation of our scientific exhibits, and I doubt that this presentation ever will be surpassed," Mr. Harrer said. The Russian participation in this phase of the conference was weak, but only because ours was such a superlative effort, he added.

Mr. Harrer, who is the associate director of Argonne's Reactor Engineering Division, commented that the United Kingdom, because of its interest in the commercial aspects of atomic energy, went all out at the industrial exhibit which also was a part of the Geneva meeting. "The English were eager to impress delegates with the capabilities of British firms in the atomic energy field, and they achieved this goal," he explained.

"In fact," he added, "it can be said that America, Russia, and England each did well what they tried to do well."

Reactor Engineering

In the area of reactor engineering, Mr. Harrer reported, Russia's work has achieved significance equal to the efforts of America and the United Kingdom combined. "The Russian announcement of their 100 megawatt power plant was a conference 'scoop' because it revealed they have more nuclear power in the works than anyone else," he added.

"The Russians frankly admitted at Geneva that because nuclear power is not yet economical, they have no pressing need for this type of power generation; they are working hard on their atomic energy program in order to disseminate information to their friends," Mr. Harrer explained.

During World War II, Mr. Harrer was involved in the start-up and operation of electrical instrumentation and power systems for electromagnetic preparation processing of U-235 at Oak Ridge, Tenn. (now the Oak Ridge National Laboratory).

He is recognized as one of the world's leading authorities on control and instrumentation of nuclear reactors.

Argonne National Laboratory is one of America's key centers for research and development of the peaceful uses of atomic energy. Development of nuclear reactors for the economical production of electrical power is one of the major objectives of the Laboratory, which is operated by the University of Chicago under contract to the U. S. Atomic Energy Commission.

UNITED ENGINEERING CENTER

A Year-End Report of Progress and Problems

This is a summary of progress and problems. At the close of 1958, there was a healthy balance of progress and problems; the kind of balance that always stimulates and challenges engineers.

Progress. In a little over a year, the United Engineering Trustees and their Real Estate Committee have secured what the experts call the best site in New York, on the west side of United Nations Plaza between East 47th and East 48th Streets. This site was assembled after negotiating purchases of a variety of small properties from six different, and some difficult, owners. The last of the tenants have moved, demolition of the buildings is complete, and the site was cleared early in January. The general contractor should be selected this month. Shortly after the funds are in hand, ground breaking could take place; and if all goes well, the building can be completed by early 1961.

The architects, Shreve, Lamb, and Harmon Associates, have completed preliminary plans and called for bids on the general contract. Only a courageous architect would undertake a building for a group of engineers. In this case, courage is reinforced by experience. This firm has for many years been consulting architects to United Engineering Trustees on alterations and plans for renovation and replacement of the present building on 39th Street. Many details are yet to be settled, but the basic plan is agreed upon. There will be a 20-story tower with penthouse rising from a two-story basic structure over a basement. The gross floor area will be 280,000 sq ft. The tower will be approximately 65 × 140 ft. The basement, and two large floors housing the library, cafeteria, and central services will occupy the United Nations Plaza block front to a depth of 225 ft on 48th Street and 150 ft on 47th Street. Present plans call for a 13-story wing to provide for expansion when needed about 15 years from now.

Problems. It isn't right to put the matter of finances entirely under the head of "problems." More than half of this story belongs under "progress." Of the $8 million needed, $5.5 million have been given in cash or pledged by the end of December, 1958. Two hundred eighty-four industry Gifts totaling $3.85 million have been received. Thirty-two thousand members have given $1.65 million. Seventeen and seven tenths per cent of the Founder Society members have given 55 per cent of the member-gifts quota. More than 40 local Sections of the Founder Societies have met and exceeded their quotas. That's progress.

The only real problem is how to put clearly before every member of the Founder Societies the importance and urgency of this project. Every local Section that has made a personal appeal to every member has exceeded its quota. There is every reason to be sure that the job can be done as it should be; on a man-to-man basis where the member lives and works.

The consequences of failure are unthinkable. More than 50 years ago, the original three "Founder Societies," numbering 16,000, less than a tenth of the total membership of the present five, 180,000, raised by member subscriptions over a half million dollars (1907 dollars, that is) to buy the ground and help build the present headquarters on 39th Street. The gift of Andrew Carnegie, $1,050,000, then was of a relative size comparable with what industry is undertaking to do now considering inflation, increased building costs, and wealth of the industry today. It is hard to believe that these 50 years have brought a regression in professional consciousness and pride that would permit a failure in this campaign. We can't settle for less of a building; we can't afford a mortgage; we can't continue to serve our growing membership efficiently in our present location.

Engineering, as an organized profession is facing a test. There is much talk of "unity"; there is said to be need for a "survey"; there is talk of "testing the grass roots." This campaign for a modest sum of money will serve well for all of these purposes. If we can't successfully take this small step toward a simple, tangible goal in unison, we have our answer. That's all the survey we need. Truly, the consequences of failure are unthinkable. So, let's not think any more about them, and get on with the job. We are a little behind schedule!

What do we do when we get behind schedule? We put in some overtime. Member campaign solicitors: If you can't make it in the daytime, take a couple of evenings and call on your prospects. Members: If you haven't been solicited, call up your Section Chairman or Secretary and tell him you're ready—ready to make your own pledge, and ready to lend a hand in cleaning up the campaign in your Section.

A member of one of our Founder Societies read the campaign brochure and remarked that amounts tabulated at the end as illustrations of tax credits available on various sizes of gifts was apparently to be taken as a guide for giving to this campaign. He felt the inferred amounts were away out of line; too high. "Why," he said, "that's the kind of contribution one might make to a church building fund or to all his local charities in one year." Well, yes, maybe it would work out something like that. But then some of us feel that our profession should be housed in a worthy structure too. Like the church building fund, this is a once-in-a-lifetime, and it's tax deductible.

Member Gifts Campaign Status (As reported on January 16, 1959)

	Quota	Subscriptions	Number of Subscribers	Per Cent of Quota
ASCE	$800,000	$333,540.14	4,624	41.7
AIME	500,000	194,287.39	2,012	39.0
ASME	800,000	395,885.99	7,467	49.5
AIEE	900,000	629,931.69	16,176	70.0
AIChE	300,000	252,714.64	5,724	83.9
Other	....	28,784.08	244	...
Total Member Gifts		$1,835,143.93	36,247	60.8

Notes on Society Activities and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

Human Factors Professional Group Established by ASME

Purpose, objectives, and fields of interest announced with outline of proposed activities

At the 1958 Annual Meeting of The American Society of Mechanical Engineers the Council approved the Establishment of a Human Factors Group under the Professional Divisions Executive Committee.

Interest in this subject grew from the thought-provoking paper presented by Prof. T. F. Hatch of the University of Pittsburgh, at the 1954 ASME Annual Meeting, "Proposed Program in Ergonomics. . .Human Engineering." Out of the activities sparked by this paper grew the Human Factors Group. The Human Factors Group provides ASME members with society-sponsored opportunities to advance their knowledge of human factors in engineering and to contribute to the general advancement of knowledge in this field.

Objectives

The specific objectives of the Group are twofold. First, to encourage in engineering practice the attention to human factors required in the development of physical designs in order to maximize the performance of man-machine systems and minimize the problems that arise from improper man-machine interactions. Second, to promote better communications between practicing engineers and human factors scientists so that the human factors scientist may be acquainted with real problems and undertake appropriate researches, and engineers may have access to pertinent available knowledge of human capacities and limitations.

The fields regarded as within the scope of ASME interest for human factor considerations include: Any system into which man may be introduced—or any system, equipment, product, tool, or method in which there is human influence on production, operation, or maintenance. The principal concerns are with speed, accuracy, and reliability of man-machine performance in the human use and operation of equipment and systems, and in the short and long-range effects of the man-machine-environment system on the health and well being of man. Particular emphasis is on system dynamics and on displays for presenting information to human senses, controls for human operation, the layout of workplaces, and the control of the human environment.

The basic nonengineering sciences such as psychology, physiology, sociology, anthropometry, and medicine, whose specialties are prominently allied with ASME's interest in human factors, will offer new fields for exploration.

The types of knowledge pertinent to this interest include: Human characteristics and capabilities such as body size and shape, vision, hearing, intellectual abilities, reaction time, common skills and capability for learning new skills, muscular strength, mobility, and—in fact—all engineering properties of man and all system-relevant properties of man; human perception, responses, and preferences in regard to such variables as noise, temperature, humidity, emotional stress, team and group effort, light, color, vibration, motion, and pressure; and human requirements for health, safety, and comfort.

Proposed Activities

The proposed activities as set forth by the newly established group include the presentation of human factors in engineering at Society meetings, working with ASME groups and any appropriate outside organizations, as well as encouraging participation by ASME members in meetings of other organizations; organizing meetings and arranging for the papers to be presented. Plans call for the preparation of abstracts, committee work, identifying specific engineering needs for human factors information, and stimulating research and education to fill these needs. Another need the Group hopes to fill is keeping those interested in human factors acquainted with related new developments and, finally, maintaining a bibliographical service for ASME members on the subject.

Trends in Textile Engineering

The Textile Engineering Division of The American Society of Mechanical Engineers plans to hold a conference on "Trends in Textile Engineering" at Clemson College, Clemson, S. C. The annual Southern spring meeting, March 12 and 13, will feature papers and discussions on various aspects of the finishing process, the shuttleless loom, and unifil. Dr. J. C. Cook, Jr., head of the mechanical-engineering department at Clemson College, has been elected chairman of the conference. Prof. S. M. Watson is head of the Conference Arrangements Committee and John McPherson, Jr., vice-president, McPherson Company, Greenville, S. C., is chairman of the Conference Program Committee.

TRANSACTIONS Series A | TRANSACTIONS Series B | TRANSACTIONS Series C | TRANSACTIONS Series D | TRANSACTIONS Series E

ASME TRANSACTIONS QUARTERLIES: A Resume

Journal of ENGINEERING FOR POWER | Journal of ENGINEERING FOR INDUSTRY | Journal of HEAT TRANSFER | Journal of BASIC ENGINEERING | Journal of APPLIED MECHANICS

THE first quarterly of the new ASME Transactions Series—the *Journal of Engineering for Power*—was published in January, 1959. This month, the *Journal of Engineering for Industry* and the *Journal of Heat Transfer* will make their appearance. In March, 1959, the *Journal of Basic Engineering* and the *Journal of Applied Mechanics* will be published. Thus, the *Transactions of the ASME* will be issued, henceforth, as a series of five quarterlies.

Fifth Quarterly Added

Originally the plans to split the Transactions called for the publication of four quarterlies (See MECHANICAL ENGINEERING, May, 1958, p. 55; June, 1958, pp. 128–129; September, 1958, p. 104).

However, before this new program could be implemented, a need for still a fifth quarterly arose which would cover the field of heat transfer. In recent years the engineering science of heat transfer has expanded rapidly. So much so that over the past eight to ten years the publication space utilized by papers processed through the ASME Heat Transfer Division has grown steadily until in 1957 a total of 509 pages or 25.8 per cent of Transactions space was used as an outlet for Heat Transfer Division sponsored papers. Recognizing this rapid growth, coupled with the general interest of a large segment of the ASME membership in the subject of heat transfer, the Publications Committee on November 17, 1958, recommended that a *Journal of Heat Transfer* be added to the new Transactions series. This action was subsequently approved by the Board on Technology on Nov. 18, 1958, and by the Council on Nov. 29, 1958.

Since heat-transfer material was originally assigned to the *Journal of Basic Engineering*, the *Journal of Heat Transfer* will be provided without additional cost to member subscribers of *Basic Engineering* for fiscal 1958–1959, after which period it will be placed on a separate subscription basis as are the other four journals in the Transactions series.

Contents of Journals

The five new quarterlies will cover the following subjects:

Journal of Engineering for Power. Divisions: Power, Gas Turbine Power, Nuclear Engineering, Fuels, and Oil and Gas Power; Research Committees: Furnace Performance Factors, Corrosion and Deposits from Combustion Gases, Boiler Feedwater Studies, High-Temperature Steam Generation, Condenser Tubes, and Properties of Steam; Committees on: Air Pollution Controls and Solar Energy Application; and Power Test Codes Committees.

Publication dates: January, April, July, and October.

Journal of Engineering for Industry. Divisions: Aviation, Machine Design, Management, Process Industries, Maintenance and Plant Engineering, Railroad, Production Engineering, Materials Handling, Rubber and Plastics, Petroleum, Safety, Textile, Wood Industries; Research Committees: Metal Processing, Flow of Bulk Materials, Elevators, Mechanical Springs.

Publication dates: February, May, August, and November.

Journal of Heat Transfer. Radiation, Conduction, Convection, Complex Systems, Phase Changes and Mixtures, Transient Phenomena, Thermophysical Properties, Experimental Techniques, Thermometry, Analog Methods, Analytical and Numerical Methods, Applications, Design Techniques, Heat Exchangers, Insulation, Economic Factors, Biotechnology, and Astronautics.

Publication dates: February, May, August, and November.

Journal of Basic Engineering. Divisions: Lubrication, Hydraulic, Instruments and Regulators, and Metals Engineering; Research Committees: Automatic Regulation Theory, Effect of Temperature on the Properties of Metals, Fluid Meters, Prevention of Fracture in Metals, Mechanical Pressure Elements, Lubrication, Plastic Flow of Metals.

Publication dates: March, June, September, and December.

Journal of Applied Mechanics. Dynamics, Vibration, Elasticity, Lubrication and Wear, Rheology, Fractures, Structures, Hydraulics, Aerodynamics, Internal Flow, Mechanical Properties of Metals, Thermodynamics, Turbulence, Heat Transfer, Computing Devices and Methods, Boundary Layers, Aeroelasticity, and Experimental Stress Analysis.

Publication dates: March, June, September, and December.

As formerly, only high-quality, permanent-interest, or reference-type papers will be included in these new journals, and the selection will be made by the Professional Divisions and Research and other Special Committees of the ASME whose members are constantly in touch with the laboratories, production centers, and field stations where engineering takes its first forward steps.

Prices

The price schedule adopted for the new quarterlies is as follows:

No. of Journals	Member Price	Nonmember Price
1	$ 5.00	$10
2	9.00	18
3	12.50	25
4	15.00	30
5	16.50	33

The individual price of a single issue is $1.50 to members and $3 to nonmembers.

Rising printing costs (60 per cent since 1945) and an increased volume of material to be published (90 per cent since 1945) have dictated these new rates.

Subscription orders should be sent to the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

ASME COMMITTEES

The Society's tools for serving its field; opportunities for members to expand their activities

By C. B. Peck, ASME Organization Committee

The work of The American Society of Mechanical Engineers, like that of all professional societies, is carried on by volunteer committees, assisted by a full-time secretarial staff. These committees are of two types, depending on whether their primary responsibilities are technical or administrative. Most technical committees perform some administrative duties and many primarily administrative committees are responsible for some phases of the technical program of the Society.

Administrative committees organize meetings, plan programs, carry out the Society's publication policies, and supervise the affairs of the Society and of its Sections and Professional Divisions. They maintain the membership qualification standards and deal with its outside relations. Here membership qualifications for some committees are professional; for others they call for knowledge and experience in the operation of various phases of the Society organization.

Technical committees deal with codes and standards, research projects, and special assignments such as the Metals Engineering Handbook. The members are selected for their knowledge and experience in the specialty with which the committee is to deal.

Committees meet at many locations. There are 89 Sections, 19 subsections, and nine groups; 24 Professional Divisions and one group; and eight Regions with headquarters scattered all over North America where committees meet. In addition to the Professional Division committees, there are 18 Research Committees and administrative committees on meetings, publications, and special subjects under the Board on Technology, 86 on safety, standardization, and codes under the Board on Codes and Standards, nine under the Boards on Honors, Membership, Public Affairs, and Education, and three reporting directly to Council. Some, but not all, of these committees meet in New York.

In any consideration of committee membership two facts should be kept in mind. First, one's committee membership is entirely voluntary unless, in rare cases, compulsion is exerted by his employer. Because of this fact and its corollary that the amount of service that the committee renders is also voluntary, it is necessary to use great care and exercise sound judgment in selecting committeemen. The health of the Society requires that, in addition to ability and personality, they bring to the job a keen sense of responsibility and enthusiasm for the task.

How Are Committeemen Made?

How are committeemen made? The process begins at the grass roots. There are three fields of activity from which the first steps toward committee responsibility may be taken: Sections, Professional Divisions, and Junior activities. It is occasionally necessary to go outside the engineering profession for special talent, particularly where interests outside the Society are affected by the work of the committee, as, for instance, is the case with the Boiler Code Committee. Such men are not appointed, however, until the need for their services is thoroughly established.

Sections offer opportunities for service to the greatest number of members. Each member of the Society on the North American continent is automatically a member of a Section. These Sections are geographically compact enough so that meetings and other activities are within reach of a high percentage of the members. Any member, particularly a young member, who feels that he has something to contribute to his profession or who wishes to avail himself of the valuable self-development which comes with committee service, should become an active member of his Section. From this step forward his progress in service and the assumption of responsibility will depend upon his particular kind of ability and on his personality.

Professional Divisions are less closely associated with the membership at large than Sections. However, for those with well-defined professional interests, they offer opportunities for service which, through the contribution of papers or discussions of papers at Professional Division sessions or national conferences, will place men of ability who demonstrate a willingness to work in line for committee assignments. Somewhere among the 25 Professional Divisions, every young man will find one or more which deal with some phase of the field of his choice. As his experience grows and he becomes more deeply involved in the problems of his field, there may be opportunities for useful service on one of the research or code committees.

The organized Junior activities of the Society have been the starting point of many men who have contributed and are now contributing greatly to the quality and effectiveness of its service to the profession.

Whatever the starting point of one's service to the Society, he need not worry that he will not be sought for committee duty if he demonstrates ability and willingness to work. There is never a surplus of high-quality committee material.

Choice of Committeemen

Choice of committeemen is limited by the small percentage of the membership who are willing to contribute anything but their dues to the Society in return for what they receive from it. The Membership Survey of 1954 disclosed that, of the 20,000 members who replied to the questionnaire as to Society activity, only 15 per cent attended half or more of their Section meetings; over half attended no meetings at all. No doubt some members who take no part in Section activities are active in Professional Divisions. However, it seems evident that far too many members are missing opportunities for service to the Society and for the broad personal development which is a corollary of service to the Society.

The industries which employ mechanical engineering in the development and design of their product or in their manufacturing processes are generally aware of the benefit which accrues to all such industry from the work of The American Society of Mechanical Engineers. Many of them, particularly the larger companies, willingly support this work by making their engineers available for committee jobs and make it possible for them to attend meetings. These companies are specially benefited by the increase in the value of their employees who have become active in the work of their professional society.

Sections, through their close relationship with local industries, are strategically situated to broaden this base of support.

Turbines in Action Theme of Fourth Annual ASME Gas Turbine Conference

Turbines in action is the theme for the fourth annual conference and exhibit sponsored by the Gas Turbine Power Division of The American Society of Mechanical Engineers. The three-day meeting to be held at the Netherlands-Hilton Hotel, Cincinnati, Ohio, March 8–11, also features an exhibit of the latest in designs and equipment in the turbine field.

The technical program is to be presented in five sessions which deal with marine, aircraft, heat-exchanger application, and gas-turbine-component design topics.

Among the papers scheduled for presentation are included those on analysis of the performance of a supersonic exhaust nozzle for turbojet engines, experience with gas-turbine ships, development of a three-stage liquid-cooled turbine, and a boost power turbine for naval propulsion.

Inspection trips to the General Electric Aircraft Turbine plant in Evandale and the Cincinnati Milling Machine Company are also an important part of the program.

The following is the tentative program.

▶SUNDAY, MARCH 8

Registration **3:00 to 6:00 p.m.**

▶MONDAY, MARCH 9

Registration **8:00 a.m. to 5:00 p.m.**

Authors' Breakfast **8:00 a.m.**

Exhibits open **8:30 a.m. to 6:30 p.m.**

Session 1 **9:00 a.m. to 11:30 a.m.**

Chairman: *J. S. Alford*

Vice-Chairman: *F. L. Schwartz*

Summary of Parametric Design Studies of a 250-HP Free-Shaft Gas-Turbine Aircraft Engine,[1] by *S. H. Spooner*, U. S. Army Transportation Research and Engineering Command

A Transport Aft-Turbofan,[1] by *B. E. Sells* and *W. R. Dodge*, General Electric Co., Aircraft Gas Turbine Dvision

The Development of the Bristol Turboprop to 2000-Hour Life Between Overhauls, by *P. F. Green*, Bristol-Aero Engines, Ltd.

[1] Paper not available—see box on this page.

Welcoming Luncheon **12:30 p.m.**

Speaker: to be announced

Subject: **Aircraft Gas Turbines**

Session 2 **2:30 to 5:00 p.m.**

Chairman: *O. E. Rodgers*

Vice-Chairman: *E. S. Dennison*

Analysis of Plug Nozzle for Turbojet and Rocket Exhaust,[1] by *W. H. Krase*, Rand Corp.

Design Considerations for Nuclear Aircraft Gas-Turbine Engines,[1] by *D. R. Riley*, General Electric Co., Aircraft Nuclear Propulsion Division

Relative Thermal Performance of Carbon Dioxide and Helium in Nuclear Power Cycles,[1] by *F. E. Tippets*, General Electric Co., APED

Session 3 **7:30 p.m. to 10:00 p.m.**

Chairman: *B. O. Buckland*

Vice-Chairman: *R. Tom Sawyer*

Gas-Turbine Operating Experience in the Petrochemical Industry,[1] by *J. O. Stephens*, Westinghouse Electric Corp.

Gas Turbines Yesterday, Today, Tomorrow,[1] by *A. H. Carameros*, El Paso Natural Gas Co.; and *W. B. Moyer*, General Electric Co.

40,000-KW Gas Turbine Power Plant, Mayagüez, Puerto Rico,[1] by *Z. S. Stys*, Brown Boveri Corp.

▶TUESDAY, MARCH 10

Authors' Breakfast **8:00 a.m.**

Exhibits open **8:30 a.m. to 6:30 p.m.**

Registration **8:00 a.m. to 5:00 p.m.**

Session 4 **9:00 a.m. to 11:30 a.m.**

Chairman: *H. R. Hazard*

Vice-Chairman: *A. L. London*

Application of Electrical Analog Theory to the Solution of Heat-Transfer and Aerodynamic Problems Encountered in High-Temperature Turbine Design,[1] by *R. Lang*, Curtiss-Wright—Research

Development of a Three-Stage, Liqud-Cooled Gas Turbine,[1] by *S. Alpert, R. E. Grey*, and *W. O. Flaschar*, Solar Aircraft Co.

Some General Studies in Lightweight Blading,[1] by *C. E. Danforth*, General Electric Co., Aircraft Gas Turbine Division

Session 5 **2:00 p.m. to 5:00 p.m.**

Chairman: *W. A. Turunen*

Vice-Chairman: *J. H. Anderson*

The Basic Heat-Transfer and Flow-Friction Characteristics of Six Compact High-Performance Surfaces,[1] by *W. M. Kays*, Stanford Univ.

The Transient Response of Gas-Turbine Plant Heat Exchangers—Regenerators, Intercoolers, Precoolers, and Ducting,[1] by *A. L. London, F. R. Biancardi*, and *J. W. Mitchell*, Stanford Univ.

Rotary Regenerators for the Whirlfire Vehicular Gas Turbines,[1] by *P. T. Vickers*, General Motors—Research

Session 6 **7:30 to 10:00 p.m.**

Chairman: *W. G. Cornell*

Vice-Chairman: *F. C. Linn*

Effect of Ambient and Fuel Pressure on Spray Drop Size,[1] by *S. M. DeCorso*, Westinghouse Electric Corp.

Development of a Design Method for Axial Flow Turbine Including Design and Test of a Typical Flow Stage,[1] by *F. Baumgartner*, Boeing Airplane Co.

Torsion of a Prismatical Bar Whose Section Is a Crescent, by *F. Sisto*, Curtiss-Wright Research Division

▶WEDNESDAY, MARCH 11

Authors' Breakfast **8:00 a.m.**

Exhibits open **8:30 a.m. to 3:30 p.m.**

Registration **9:00 a.m. to 11:30 a.m.**

Session 7 **9:00 a.m. to 11:30 a.m.**

Chairman: *Ivan Monk*

Vice-Chairman: *L. C. Hoffman*

A Light-Weight 8000-HP Gas Turbine for Marine Propulsion,[1] by *V. Proscino*, Westinghouse Electric Corp.

Description and Service Experience of Various Boeing Gas-Turbine Marine Applications,[1] by *V. A. Yeager*, Boeing Aircraft Co.

Operating Experience With Gas-Turbine Ships of the Maritime Administration,[1] by *D. H. Specht* and *C. D. Tangerini*, U. S. Maritime Administration

ASME Papers by Mail

Only *numbered* papers in this program are available in separate copy form until Jan. 1, 1960. Copies may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 40 cents each to members of ASME; 80 cents each to non-members. Papers must be ordered by the paper numbers listed in this program, otherwise the order will be returned. The final listing of available technical papers will be found in the issue of Mechanical Engineering containing an account of the Conference.

Basic Concepts in Instrumentation and Control—Topic of IRD Conference

The fifth annual Instruments and Regulators Conference will highlight basic limitations, basic concepts, and methodology as applied to difficult instrumentation and control problems. The areas for discussion include the use of modern high-speed digital and analog computers.

The conference to be held March 30 through April 1, 1959, at Case Institute, Cleveland, Ohio, is sponsored by the Instruments and Regulators Division of The American Society of Mechanical Engineers with participation by the Instrument Society of America, the American Institute of Electrical Engineers, the American Institute of Chemical Engineers, the Professional Group on Automatic Control of the Institute of Radio Engineers, and the ASME Process Industries Division.

▶MONDAY, MARCH 30

Authors' Breakfast **8:00 a.m.**

Quantized Data Systems, Session 1 **9:30 a.m.**

Shannon's Theory and Feedback Systems,[1] by *S. S. L. Chang*, New York Univ.

A New Approach to the Solution of Filtering and Predictions Problems,[1] by *R. E. Kalman*, RIAS, Baltimore, Md.

[1] Paper not available—see box on page 131.

Registration

A registration desk will be located in Tomlinson Hall. Registration will be scheduled as follows:

Sunday, March 29
(for early arrivals)
5:00 p.m. to 9:00 p.m.

Monday, March 30
8:30 a.m. to 3:00 p.m.
5:30 p.m. to 7:30 p.m.

Tuesday, March 31
9:00 a.m. to 3:00 p.m.
5:30 p.m. to 7:30 p.m.

Wednesday, April 1
9:00 a.m. to 12:00 noon

Heat Exchangers, Analysis, and Experiment, Session 2 2:30 p.m.

Frequency Response of Multipass Shell and Tube Heat Exchangers,[1] by *L. Iscol* and *R. J. Altpeter*, Univ. of Wisconsin

Control of Shell and Tube Heat Exchangers,[1] by *A. R. Catheron* and *S. Goodhue*, The Foxboro Co., Foxboro, Mass.

Dynamic Response and Control of Multipass Heat Exchangers,[1] by *M. Masubuchi*, Yokohama National Univ., Japan

New Control Concepts, Session 3 7:00 p.m.

Novel Controls Using a Dead-Time Analogue,[1] by *O. J. M. Smith*, Univ. of California, Berkeley

Analytical Comparison of the Linear and Bang-Bang Control of Pneumatic Servomechanisms,[1] by *P. F. Meyfarth*, M.I.T.

Social Period 9:30 p.m.

▶TUESDAY, MARCH 31

Authors' Breakfast 8:00 a.m.

Operation of Large-Scale, Complex Systems, Session 4 9:30 a.m.

Human Body as an Inconstant Heat Source and Its Relation to Determination of Clothes Insulation, Part 1,[1] by *A. S. Iberall*, Rand Development Corp., Cleveland, Ohio

Human Body as an Inconstant Heat Source and Its Relation to Determination of Clothes Insulation, Part 2,[1] by *A. S. Iberall*, Rand Development Corp., Cleveland, Ohio

The Storage and Retrieval of Nonnumerical Data in Large and Complex Documentation Systems,[1] by *A. Kent* and *J. W. Perry*, Western Reserve Univ.

Luncheon 12:30 p.m.

Field Trips 2:00 p.m.

Hydraulic Control Systems Design and Analysis, Session 5 2:30 p.m.

Analysis of Electrohydraulic Pressure-Control Servovalve Performance and Loads,[1] by *W. L. Kinney*, Cook Research Labs.

The Design and Analysis of a Servovalve With Flow Feedback, by *E. Bahniuk*, Pesco Products Division, Borg-Warner Corp., Bedford, Ohio; and *S. Y. Lee*, Department of Mechanical Engineering, M.I.T. (ASME Paper No. 59—IRD-3)

Banquet 7:00 p.m.

Social Period 9:30 p.m.

▶WEDNESDAY, APRIL 1

Authors' Breakfast 8:00 a.m.

System Analysis, Session 6 9:30 a.m.

Load-Frequency-Voltage Control for Power Systems Using Statistical Methods,[1] by *M. Mesarovic*, M.I.T.

Estimating the Roots of the Characteristic Determinant for Multicoupled Systems, by *S. Lees*, Instrumentation Laboratory, M.I.T.; *H. D. Felsenthal*, Naval Air Missiles Center, Point Magu, Calif.; and *E. M. Goldberg*, Naval Air Development Center, Johnsville, Pa. (ASME Paper No. 59—IRD-2)

A Thermocouple System for Measuring Turbine-Inlet Temperatures, by *M. E. Ihnat* and *W. C. Hagel*, Measurements Laboratory, Instrument Department, General Electric Co., West Lynn, Mass. (ASME Paper No. 59-IRD-1)

Luncheon 12:30 p.m.

Availability of Papers

ASME papers for this program will be available as part of registration. Numbered ASME papers in this program are available in separate copy form until Dec. 31, 1959. Copies may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, New York. Prices are 40 cents to members of ASME, and 80 cents to nonmembers. Papers must be ordered by the paper numbers in this program, otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the Conference.

ASME-AIEE Railroad Conference Program Announced

THE Railroad Conference of the Railroad Division of The American Society of Mechanical Engineers and the Land Transportation Group of the American Institute of Electrical Engineers will be held at the Hotel Sheraton, Chicago, Ill., April 8 and 9

▶WEDNESDAY, APRIL 8

Session 1 9:00 a.m.

Chairman: *A. V. Dasburg*, manager, Yard and Terminal Development, General Railway Signal Co., Rochester, N. Y.

Vice-Chairman: *R. W. Seniff*, manager of research, Baltimore & Ohio Railroad Co., Mt. Clare, Baltimore, Md.

Freight-Car Tractive Resistance Measurements by Doppler Radar,[1] by *R. D. Campbell*, Union Switch and Signal Co., Swissvale, Pa.

A Method for Automatic Control of Car Retarders, by *H. C. Kendall* and *J. H. Auer, Jr.* General Railway Signal Co., Rochester, N. Y. (AIEE Paper No. CP—1230)

An Automatic Speed-Control System for a Gravity-Freight-Classification Yard,[1] by *R. J. Berti*, Union Pacific Railroad; and *T. J. Dosch*, Reeves Instrument Corp., Omaha, Neb.

Session 2 2:30 p.m.

Chairman: *A. V. Dasburg*, manager, Yard and Terminal Development, General Railway Signal Co., Rochester, N. Y.

Vice-Chairman: *R. W. Seniff*, manager of research, Baltimore & Ohio Railroad Co., Mt. Clare, Baltimore, Md.

Technical Research on European Railroads,[1] by *P. V. Garin*, Southern Pacific Co., San Francisco, Calif.

Freight-Car Roller-Bearing Capacity Effect on Life,[1] by *A. D. Edelman*, Hyatt Bearings Division, General Motors Corp., Harrison, N. J.

Machinery for Mechanized Railway Maintenance,[1] by *G. M. Magee*, Association of American Railroads, Chicago, Ill.

▶THURSDAY, APRIL 9

Session 3 9:00 a.m.

Chairman: *C. E. Tack*, vice-president and chief mechanical engineer, American Steel Foundries, Chicago, Ill.

Vice-Chairman: *D. H. Noble*, research electric engineer, Chicago Rock Island & Pacific Railroad, Chicago, Ill.

Corrosion Effects on Railway Equipment,[1] by *E. A. Foster*, Association of American Railroads, Chicago, Ill.

Characteristics of New Lightweight Commuter Cars,[1] by *J. W. Horine*, Pennsylvania Railroad, Philadelphia, Pa.

Tiedowns for Piggyback Operations,[1] by *J. A. Gower*, Pennsylvania Railroad, Philadelphia, Pa.

Session 4 2:30 p.m.

Chairman: *C. E. Tack*, vice-president and chief mechanical engineer, American Steel Foundries, Chicago, Ill.

Vice-Chairman: *D. H. Noble*, research electric engineer, Chicago Rock Island & Pacific Railroad, Chicago, Ill.

Multiple-Unit Operation of Diesel and Electric Units on the Milwaukee Railroad, by *L. Wiley*, consulting electrical engineering, Seattle, Wash. (AIEE Paper No. CP59—5000)

Detector Car History and New Developments,[1] by *H. W. Keevil*, Association of American Railroads, Chicago, Ill.

New Wheel Slip-Slide Detection and Correction System, by *W. B. Zelina*, General Electric Co., Schenectady, N. Y. (AIEE Paper No. CP59—5001)

ASME Papers by Mail

ONLY *numbered* ASME papers in this program are available in separate copy form until Feb. 1, 1960. Copies may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 40 cents each to members of ASME; 80 cents each to nonmembers. Papers must be ordered by the paper numbers listed in this program otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the Conference.

[1] Paper not available—see box on this page.

February 23–26

ASME Symposium on Thermophysical Properties, Purdue University, Lafayette, Ind.

March 8–11

ASME Gas Turbine Power Conference and Exhibit, Netherlands Hilton Hotel, Cincinnati, Ohio

March 9–12

ASME Aviation Conference, Statler Hilton Hotel, Los Angeles, Calif.

March 12–13

ASME Textile Engineering Conference, Clemson College, Clemson, S. C.

March 16–17

ASME Lubrication Conference, The Franklin Institute, Philadelphia, Pa.

March 29–April 1

ASME Instruments and Regulators Conference, Case Institute of Technology, Cleveland, Ohio

March 31–April 2

American Power Conference, Hotel Sherman, Chicago, Ill.

April 5–10

Nuclear Congress, Cleveland Auditorium, Cleveland, Ohio

April 8–9

ASME-AIEE Railroad Conference, Sheraton Hotel, Chicago, Ill.

April 13–15

ASME Hydraulics Conference, University of Michigan, Ann Arbor, Mich.

ASME COMING EVENTS

April 19–23

ASME Oil and Gas Power Conference, Shamrock Hilton Hotel, Houston, Texas

April 23–24

ASME-SAM Management Conference, Statler Hilton Hotel, New York, N.Y.

April 29–May 3

ASME Metals Engineering Conference, Sheraton-Ten Eyck Hotel, Albany, N.Y.

May 4–5

ASME Maintenance and Plant Engineering Conference, Edgewater Beach Hotel, Chicago, Ill.

May 12–14

ASME Production Engineering Conference, Statler Hilton Hotel, Detroit, Mich.

May 25–28

ASME Design Engineering Conference, Convention Hall, Philadelphia, Pa.

June 14–18

ASME Semi-Annual Meeting, Chase-Park Plaza Hotel, St. Louis, Mo.

June 18–20

ASME Applied Mechanics Conference, Virginia Polytechnic Institute, Blacksburg, Va.

August 9–12

ASME-AIChE Heat-Transfer Conference, University of Connecticut, Storrs, Conn.

September 10–12

ASME Wood Industries Conference, Multnomah Hotel, Portland, Ore.

September 17–18

ASME-AIEE Engineering Management Conference, Statler Hilton Hotel, Los Angeles, Calif.

September 20–23

ASME Petroleum Mechanical Engineering Conference, Rice Hotel, Houston, Texas

September 27–October 1

ASME-AIEE National Power Conference, Hotel Muehlebach, Kansas City, Mo.

October 20–22

ASME-ASLE Lubrication Conference, Hotel Sheraton-McAlpin, New York, N. Y.

November 29–December 4

ASME Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N.J.

(*For Meetings of Other Societies, see page 115*)

Note: Members wishing to prepare a paper for presentation at ASME national meetings or divisional conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N.Y., for which there is no charge providing you state that you are a member of ASME.

First ASME Hydraulics Conference to Be Held at University of Michigan

The first annual conference of the Hydraulic Division of The American Society of Mechanical Engineers will be held at the University of Michigan, Ann Arbor, Mich., April 13–15.

The program will be presented during six technical sessions, and the subjects to be discussed include cavitation, hydraulic turbines and water hammer, fluid mechanics and fluid power systems, and pumping machinery and compressors.

▶MONDAY, APRIL 13

Registration 8:30 a.m.

Cavitation, Session 1 9:30 a.m.

Chairman: *James W. Daily*, professor of hydraulics, hydrodynamics laboratory, Massachusetts Institute of Technology, Cambridge, Mass.

Welcome: *Stephens S. Attwood*, dean, College of Engineering, University of Michigan, Ann Arbor, Mich.

The Inception of Cavitation on Isolated Surface Irregularities, by *J. W. Holl*, Ordnance Research Laboratory, Pennsylvania State Univ. (Paper No. 59—Hyd-12)

ndentation of Metals by Cavitation,[1] by *W. H. Wheeler*, United Kingdom Ministry of Supply, Melbourne, Australia

Luncheon 12:15 p.m.

Speaker: *Dr. Pierre Danel*, chief research engineer, Neypric Co., Grenoble, France.

Hydraulic Turbines and Water Hammer, Session 2 2:30 p.m.

Chairman: *John Parmakian*, construction engineer, Bureau of Reclamation, U. S. Department of the Interior, Denver Federal Center, Denver, Colo.

Vice-Chairman: *R. H. Pepper*, sales engineer, Newport News Shipbuilding and Dry Dock Co., Newport News, Va.

Influence of Trailing Edge Geometry on Hydraulic Turbine-Blade Vibration Resulting From Vortex Excitation, by *G. Heskestad* and *Duane R. Olberts*, research laboratory, Allis-Chalmers Manufacturing Co., Milwaukee, Wis. (Paper No. 59—Hyd-7)

Propeller Turbines for St. Lawrence, by *G. G. Fintak*, hydraulic department, Allis-Chalmers Manufacturing Co., Milwaukee, Wis. (Paper No. 59—Hyd-11)

Volume Viscosity and Its Relation to Water Hammer and Other Fluid Phenomena,[1] by *H. M. Paynter*, M.I.T. and *F. D. Ezekiel*, Mechanical Engineering Division, M.I.T.

Vibration of Water-Turbine-Draft Tube,[1] by *M. Murakami*

[1] Paper not available—see box on this page.

Availability of Papers

ASME papers for this program will be available as part of registration. Numbered ASME papers in this program are available in separate copy form until Dec. 31, 1959. Copies may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, New York. Prices are 40 cents to members of ASME and 80 cents each to nonmembers. Papers must be ordered by the paper numbers in this program, otherwise the order will be returned. The final listing of available technical papers will be found in the issue of Mechanical Engineering containing an account of the Conference.

Water-Hammer Damage to Oigawa Power Station (Japan), by *C. C. Bonin*, Ebasco Services, Inc., New York, N. Y. (Paper No. 59—Hyd-8)

Fluid Mechanics (I), Session 3 7:30 p.m.

Chairman: *S. J. Kline*, assistant professor, Me-

chanical Engineering Division, Stanford Univ., Stanford, Calif.

Vice-Chairman: *W. L. Stewart*, Lewis Research Center, NASA, Cleveland, Ohio

A Shock-Tube Technique to Determine Steady-Flow Losses of Orifices and Other Duct Elements, by *G. Rudinger*, Cornell Aeronautical Lab., Inc., Buffalo, N. Y. (Paper No. 59—Hyd-13)

Separation Prediction for Conical Diffusers,[1] by *J. M. Robertson*, Talbot Laboratory, Univ. of Illinois

Unsteady Transfer of Momentum and Heat Between Concentric Cylinders,[1] by *C. S. Yih*, Univ. of Michigan

▶TUESDAY, APRIL 14

Registration 8:00 a.m.

Fluid Mechanics (II), Session 4 9:00 a.m.

Chairman: *R. C. Dean*, head, advanced engineering department, Ingersoll-Rand Co., Phillipsburg, N. J.

Vice-Chairman: *H. Yeh*, professor of mechanical engineering, Univ. of Pennsylvania, Philadelphia, Pa.

Chamber Dimension Effects on Induced Flow and Frictional Resistance of Enclosed Rotating Disks, by *J. W. Daily* and *R. E. Nece*, Hydrodynamics Laboratory (Paper No. 59—Hyd-9)

The Three-Dimensional Turbulent Boundary Layer, by *J. P. Johnston*, Ingersoll-Rand Co., Phillipsburg, N. J. (Paper No. 59—Hyd-6)

Three-Dimensional Flow Considerations in the Design of Turbines, by *W. L. Stewart*, Turbodrive Section, *W. J. Whitney* and *H. J. Schum*, Lewis Research Center, NASA, Cleveland, Ohio (Paper No. 59—Hyd-1)

Luncheon 12:30 p.m.

Speaker: *G. V. Edmonson*, associate dean, College of Engineering, Univ. of Michigan, Ann Arbor, Mich.

Inspection Tour of Laboratories at the University of Michigan 2:30 p.m.

Banquet 8:00 p.m.

Speaker: *J. C. Ayres*, professor, Great Lakes Research Institute, Univ. of Michigan, Ann Arbor, Mich.

▶WEDNESDAY, APRIL 15

Registration 8:00 a.m.

Pumping Machinery and Compressors, Session 5 9:00 a.m.

Chairman: *W. C. Osborne*, manager of engineering, Harrison Division, Worthington Corp., Harrison, N. J.

Vice-Chairman: *H. Gartmann*, chief engineer, centrifugal pump and compressor department, De Laval Steam Turbine Co., Trenton, N. J.

An Experimental Investigation of Radial Thrust in Centrifugal Pumps, by *A. Agostinelli, D. Nobles*, and *C. Mockridge*, engineering department, Worthington Corp., Harrison, N. J. (Paper No. 59—Hyd-2)

Volute Pressure Distribution, Radial Force on the Impeller, and Volute Mixing of a Radial Flow Centrifugal Pump, by *H. W. Iversen, R. E. Rolling*, and *J. J. Carlson*, Univ. of California, Berkeley (Paper No. 59—Hyd-10)

Design and Test of Mixed Flow and Centrifugal Impellers,[1] by *J. J. Kramer, W. M. Osborn*, Lewis Research Center, NASA, Cleveland, Ohio; and *J. T. Hamrick*, Thompson Products Co., Inc., Rocky Mount, Va.

Luncheon 12:15 p.m.

Speaker: *J. Parmakian*, Chairman, ASME Hydraulic Division

Subject: **What Has Been Accomplished at This First Annual Hydraulic Division Conference?**

Fluid Mechanics (III) and Fluid Power Systems, Session 6 2:30 p.m.

Chairman: *J. E. Fowler*, development engineer, General Electric Co., Schenectady, N. Y.

Vice-Chairman: *V. L. Streeter*, professor of hydraulics, Univ. of Michigan, Ann Arbor, Mich.

Crossover System Between the Stages of Centrifugal Compressors, by *G. O. Ellis*, Carrier Corp., Syracuse, N. Y. (Paper No. 59—Hyd-3)

Ejector Nozzle Flow and Thrust, by *H. E. Weber*, Flight Propulsion Laboratory, General Electric Co., Danville, Calif. (Paper No. 59—Hyd-5)

Discharge Coefficients and Steady-State Forces for Hydraulic Poppet Valves,[1] by *J. A. Stone*, International Business Machines Corp., Boston, Mass.

Pressure Losses in Smooth Pipe Bends, by *H. Ito*, Institute of High-Speed Mechanics, Tohoku Univ., Sendai, Japan. (Paper No. 59—Hyd-4)

Conducted for the National Junior Committee

N.J.VIEHMANN

JUNIOR FORUM

The Structure of ASME

By E. T. Selig[2]

EVERY engineer desires to know what his professional society is doing for him and what it is doing for his profession as a whole. A cognizance of the structure of the society and its activities is essential if these questions are to be answered. This article has been prepared to provide this information with regard to the ASME.

The Council. The affairs of the Society are administered by the Council, elected from the membership of ASME. The Council consists of the president, the last three past-presidents, eight vice-presidents, one from each of the eight regions of the Society, and ten directors. The Council appoints from among its members an Executive Committee consisting of the president, two vice-presidents, and two directors. The chairman of the Finance Committee and of the Organization Committee sit on the Executive Committee as nonvoting advisory members. During the intervals between sessions of the Council, the Executive Committee handles the business of the Society.

Reporting directly to the Council are four major committees: Finance, Organization, Professional Practice, and Constitution and By-Laws; a number of special committees; and six boards: Technology, Codes and Standards, Membership, Education, Honors, and Public Affairs (see ASME Manual MM-2). The work of the Society is carried out through these boards and committees with the help of a Secretarial Staff of approximately 140 persons, under the direct administration of the Secretary.

Committees. The financial operations of the Society, which involve over $2 million a year, are guided by the Finance Committee with the advice of an investment counsel.

The Organization Committee reviews the organization and personnel of the boards and committees of the Society and recommends to the Council policies and procedures pertaining to their effective operation and committee appointments.

The Professional Practice Committee recommends policies and procedures by which the Society may improve the status of engineers and maintain a high standard of ethical practice. The Committee supervises activities of the Society related to professional practice of engineering in various capacities, and over the Canons of Ethics and their enforcement.

Organizational changes necessitated by the continual expansion of the activities of ASME require constant revision and interpretation of the Rules and By-Laws of the Society. The Constitution and By-Laws Committee has this responsibility.

Boards. The Board on Technology has supervision of five standing committees: Meetings, Publications, Professional Divisions, Research, and Technical Development. These help to fulfill a major objective of the Society, the dissemination of technical information.

[1] Product Planning Engineer, Western Electric Company, North Andover, Mass. Assoc. Mem. ASME.

[2] Assistant research engineer, Armour Research Foundation, Chicago, Ill. Assoc. Mem. ASME.

The Meetings Committee is responsible for the national meetings and conferences of the Society (except the Business meeting); 26 were held in 1958, some jointly with other professional societies.

In addition to MECHANICAL ENGINEERING, Transactions (which is comprised of the Journals of *Engineering for Power*, *Engineering for Industry*, *Heat Transfer*, *Basic Engineering*, and *Applied Mechanics*) and *Applied Mechanics Reviews*, the Society has issued more than 425,000 individual pamphlet copies of technical papers, and has maintained a stock of about 300 books, pamphlets, and other publications. These come under the jurisdiction of the Publications Committee.

The Professional Divisions Executive Committee together with its subcommittee, the Professional Divisions Planning Committee, has supervision of the activities of the Professional Divisions and Groups of the Society. A Group is a technical division whose membership is not large enough to warrant its official formation as a Professional Division. It is the object of a Division to promote the arts and sciences of the technical area which it represents. For example, in 1958, Divisions sponsored 22 conferences at which specific fields of engineering were explored in depth.

ASME conducts research for the purpose of filling voids in technical knowledge and resolving conflicts in engineering data in fields of general importance. The Research Executive Committee with its Research Planning Committee supervises these activities. Funds to conduct the research projects come primarily from the United Engineering Trustees, private corporations, and trade associations. Each project is under the supervision of a special ASME committee whose members serve without financial compensation. Typical of the research programs currently being carried on are investigations of the thermodynamic properties of steam, prevention of fracture of metals, lubrication, and fluid meters. ASME is also represented on several research committees of other organizations.

The Technical Development Committee is devoted to a continuous surveillance of the growth of scientific and engineering knowledge, anticipation of the need for technical society activity in new fields, and recommendations of new group activity within ASME. Specific areas now under study are: storage of energy, conservation of water resources, a new look at our concept of energy and its use by man, air sanitation, direct generation of electricity, and improved food technology and production.

A second major group under the direction of Council is the Board on Codes and Standards, with its Boiler and Pressure Vessel Committee, Power Test Codes Committee, Standardization Committee, and Safety Codes Committee. The formulation of codes and standards is one of ASME's basic contributions to public welfare, as well as to the art and science of engineering.

The early efforts of the Boiler and Pressure Vessel Committee concerned requirements for safe steam boilers and later broadened to include unfired pressure vessels in general. Applications of pressure vessels to nuclear power generation is becoming an increasingly important part of the committee's activities. The code as developed by this committee is now in legal force in 34 states and the provinces of Canada.

The Power Test Codes Committee is responsible for preparing test codes on such equipment as steam generators, turbines, pumps, compressors and internal-combustion engines, as well as requirements for instruments and apparatus to perform testing on such equipment.

The Standardization Committee handles all standardization activity in five areas: plant-layout templates, therbligs, steam turbines, piston rings, and work standardization. It serves as sponsor for the American Standards Association in 33 other areas such as screw threads, wire and sheet-metal gages, gears, pressure piping, mechanical and shock vibration, and drawings and drafting practice. It also has representatives on 31 ASA Committees.

The Safety Codes Committee sponsors ten safety committees for ASA such as those concerned with elevators, power transmission, reactor safety, and industrial trucks. It has representatives on more than 36 ASA safety committees.

Matters of membership standards, grades, entrance requirements, admissions, and increase in membership are under the jurisdiction of the Board on Membership. These responsibilities are facilitated by three committees: Admissions Committee, which determines the eligibility of the applicants for membership and for transfer in membership grades; Membership Development Committee, which directs activities pertaining to membership extension; and Membership Review Committee, which examines cases involving individual members requiring special action by the Council.

A joint professional body, the Engineers' Council for Professional Development, has among its principal objectives the improvement of engineering education and the development of young engineers. Its service of accreditation of engineering college curricula is one of its major contributions. This work of ECPD is supported by ASME through the Board on Education. Other responsibilities of the Board are development of professional understanding, engineering guidance activities, and problems concerning the legal right to practice. The latter is the function of the Engineers Registration Committee. The establishment of regional committees of mechanical-engineering college department heads is one of the recent Board achievements intended to implement these objectives.

The National Junior Committee has been established to develop programs within the Society which are of particular interest to the younger engineers, and which will help them in their professional development. The Committee encourages them to participate in the affairs of the Society. Some of the specific activities include a Junior Session at the Annual and Semi-Annual Meetings of the Society, the Junior Forum in MECHANICAL ENGINEERING, and industrial orientation programs for college students. The National Junior Committee consists of an executive group of ten Associate Members under the age of 35 and the Junior Representatives to the Boards and Committees of the Society. These representatives function as spokesmen for the younger members, and as co-ordinators for NJC.

Each year ASME presents a number of awards for distinguished service to the profession and for outstanding contributions to engineering literature. The Board on Honors is responsible for recommending to Council candidates for the Society awards, except for Honorary Membership and the ASME Medal. Recipients of the latter are selected by Council. The Medals Committee is assigned to seek candidates for the other awards and present their names to the Board. Among the awards designated for the younger engineers are the Pi Tau Sigma Gold Medal Award, Junior Award, Spirit of St. Louis Award, Williston Medal, and Postgraduate Student Award.

The Board on Public Affairs supervises the activities of the Society relating to co-operation with governmental agencies in engineering matters, participation in international activities of importance to the engineering profession, and encouragement of larger participation by engineers in public affairs. It has been concerned, for example, with the Conference of Engineering Societies and the World Power Conference. The Civic Affairs Committee supervises those activities of the

Society that are directed to securing larger participation in civic affairs by Sections and by individual engineers.

The intent of this article has been to provide a condensed picture of the structure of ASME. The Annual Report, Constitution and By-Laws, and other Society publications may be consulted for additional information.

An acquaintance with the organizational structure of the Society will be helpful to anyone who is interested in understanding ASME, its purposes, and goals.

ASME CODES AND STANDARDS WORKSHOP

Portable Tool Spindles Standardized

By E. L. Connell, Chairman, B5 TC 28

THE American Standards Association has approved the work of Technical Committee 28 on Driving and Spindle Ends for Portable Air and Electric Tools.

This American Standard is applicable to portable power tools for rotary operations such as drilling, driving threaded fasteners, grinding, polishing, and sawing.

A careful investigation of practice by the manufacturers and users of geared chucks disclosed acceptable standards for both threaded and tapered spindles. The range selected for portable tool use includes four threaded spindles and six tapered spindles. The appendix gives recommended correlation between spindle and chuck sizes. Dimensions and tolerances are given for threads and tapers.

Tools for driving threaded fasteners are divided into two groups, hexagonal chuck and shank drives and square drives which are standard on impact tools where the socket may be attached directly to anvil arbor. These square drive standards were requested by the Bureau of Ships. Their Committee called in TC-28 and a Committee from the Service Tools Institute. Several meetings were held in Washington which resulted in the agreement taking effect Jan. 1, 1955. The Service Tools Institute was interested in interchangeability between hand and power-driven sockets. The power tool manufacturers desired closer fits to get better life. The agreement on the part of the latter assumes that the arbor of the tool will be held to half the stated tolerance on the high side.

Sanders and polishers use a depressed center disk with a flanged nut which has been standard for some years at $^5/_8$ in.-11 thread. The length has been standardized at $^{15}/_{16}$ in. A similar spindle standardized at $1^1/_8$ length is specified for vertical (pneumatic) and angle (electric) grinders using threaded cup wheels. The extra length provides for a jam nut to resist the inertia effect in pneumatic grinders when power is cut. This spindle can be used with a spacer for sanding equipment.

The new rotating guard for cup wheels is provided for in the afore-mentioned spindle by adding to the $1^1/_8$ in. length adopted for the stationary guard.

All abrasive tool spindles have been selected with co-operation from the standing committee of the Grinding Wheel Institute. We have been careful to consider the requirements of the Simplified Practice Recommendation R45-57 and Safety Code ASA B7.1–1956. All driving flanges are to be fastened to the spindle. Spindle lengths for straight wheels are chosen to accommodate preferred sizes with proper correlation between spindle diameter and wheel dimensions. An appendix gives recommended maximum wheel dimensions for each spindle at 9500 and 6500 surface ft per minute.

The Air Material Command asked for the portable saw-arbor project. Careful analysis of practice indicated a trend to round arbors and we were able to agree on two sizes covering 6 through 12-in. blades.

The foundation for much of this work was laid by the Engineering Committee of the Electric Tool Institute over a period of many years. The interests of the Compressed Air and Gas Institute have been introduced through membership in TC-28 and by liaison with their Engineering Committee.

Copies are available from the ASME Order Dept., 29 W. 39th St., New York 18, N. Y.

James Dhu Andrew, Jr., Appointed to the Boiler and Pressure Vessel Committee

THE appointment of James D. Andrew, Jr., as a member of the Boiler and Pressure Vessel Main Committee was announced on August 4 by James N. Landis, President of the Society.

Mr. Andrew is executive engineer of The Babcock & Wilcox Co., Barberton, Ohio, and has had extensive experience in design and contruction of power boilers and recently super-critical pressure boilers. He is the author of the ASME Paper "Super-Critical Pressure Boilers."

Mr. Andrew is a member of the ASME and presently is serving on the Subcommitte on Power Boilers.

James Dhu Andrew, Jr.

Fifty Codes and Standards Meetings During ASME Annual Meeting

ONCE again the close relation of the codes and standards activities of the Society with its technical papers program was illustrated during the 1958 Annual Meeting.

An estimated 50 meetings of codifying and standardizing committees were held during that week, including a Power Test Code Executive Committee meeting, six Sectional Committee meetings, and the regular ASME Standardization Committee meeting; the remainder were subcommittee and technical committee meetings.

The Standardization Committee elected W. P. Kliment, Mem ASME, as chairman for the coming year, and a special certificate of appreciation was presented to the retiring chairman, Paul V. Miller, Fellow ASME.

ASME Council Meetings During Annual Meeting

Actions of 1958 ASME Council

The 1958 Council of The American Society of Mechanical Engineers met in four sessions on the afternoon and evening of November 29, and the morning and afternoon of Dec. 1, 1958, at the Statler Hilton Hotel, New York, N. Y. At the first session the following new members of the Secretary's Staff who had become associated with it during 1958 were introduced: William H. Baldwin, salesman (Cleveland); George C. Finster, Boiler and Pressure Vessel Committees assistant; Warren C. Langer, sales promotion manager; Harry R. Lehnhardt, salesman (Chicago); and Harold I. Nagorsky, controller.

There were present: members of the Council: James N. Landis, President, who presided; J. W. Barker, D. W. R. Morgan, and W. F. Ryan, past-presidents; E. W. Allardt, H. S. Aurand, W. H. Byrne, C. H. Coogan, Jr., J. H. Sams, C. H. Shumaker, R. S. Stover, and A. W. Weber, vice-presidents; E. O. Bergman, H. C. R. Carlson, G. A. Hawkins, Joseph Pope (evening session only), L. N. Rowley, R. B. Smith, V. W. Smith, and Glenn B. Warren, President-elect, directors; E. J. Kates, treasurer; O. B. Schier, II, secretary; T. A. Marshall, Jr., senior assistant secretary; D. C. A. Bosworth, W. E. Reaser, S. A. Tucker, and J. D. Wilding, assistant secretaries. Also present were: T. J. Dolan, Harold Grasse, G. R. Hahn, and J. W. Little, Vice-Presidents-elect; and R. G. Folsom and A. M. Perrin, directors-elect; E. G. Bailey, past-president; H. D. Harkins, Board on Honors; E. T. Selig, III, National Junior Committee; C. B. Campbell and R. W. Miller, Constitution and By-Laws Committee (afternoon session only); W. H. Larkin, Engineers Registration Committee (afternoon session only); J. J. Jaklitsch, Jr., Editor, and Ernest Hartford, consultant; and other members of the Secretary's staff; W. E. Letroadec, office manager, D. B. MacDougall, Field Service assistant, H. I. Nagorsky, controller, J. T. Reid, research manager; W. H. Baldwin, G. C. Finster, W. S. Langer, and H. R. Lehnhardt.

At the sessions on December 1, the same persons were present with the following additions and exceptions: Additions: E. W. Jacobson, director; F. S. Blackall, jr., A. G. Christie and A. A. Potter, past-presidents; W. E. Karg, Board on Membership; H. B. Lindstrom and W. M. Morley, National Junior Committee; W. H. Browne and J. N. Macduff, Machine Design Division; Charles Concordia, Professional Divisions Committee, Region III. The following guests were also present: J. C. Reed and R. A. Sherman (afternoon session, November 29 only), F. R. Montgomery (sessions of November 29 only); Thompson Chandler, R. L. Goetzenberger, R. T. Mees, R. S. Peterson, J. M. Simonsem, J. F. Downie Smith, H. H. Snelling, and L. W. Wallace (December 1 sessions only). Mr. Bosworth did not attend the December 1 sessions.

The following actions of the Council are of general interest.

Effect of Inflation. The President was authorized to appoint a committee to study the effect of inflation upon future operations of the Society and to instruct it to prepare a report for presentation to the Council in June, 1959.

Revision of Society Charter. The Secretary was authorized to take the necessary steps to have the ASME Charter revised at the Business Meeting in St. Louis, Mo., to provide for the increase of the governing body to manage the Society to not more than 33 members.

Annual Reports. The Annual Report of the Council was adopted and the reports of the Boards, Committees, and Representatives on Joint Activities were accepted as submitted. The Annual report of the Council was mailed to the entire membership with the January, 1959 issue of Mechanical Engineering.

Woman's Auxiliary. The annual and financial reports of the Woman's Auxiliary were received with expressions of sincere appreciation.

Constitution and By-Laws. The Council voted to submit to the membership for letter-ballot approval certain amendments to the Constitution. Certain amendments to the By-Laws, received for first reading at the meeting of June 4, 1958, were adopted, as were certain amendments to the Rules. Proposed amendments to the By-Laws were received for first reading.

Regional Realignment. The Council voted to withdraw its directive to the Organization Committee to obtain from each member of the 1958 Regional Delegates Conference a second expression of viewpoint with respect to item 26 (Regional Realignment) on the 1958 National Agenda, and to request the Vice-Presidents and Vice-Presidents-elect to prepare an item on this subject for the 1959 National Agenda.

Transactions. Approval was voted of the recommendations of the Publications Committee to establish a quarterly *Journal of Heat Transfer* as the fifth quarterly journal into which the Transactions of the ASME have been divided. (See Mechanical Engineering, May, 1958, p. 55; June, 1958, pp. 128–129; and September, 1958, p. 104.—Editor.) The first issue of the *Journal of Heat Transfer* will be published in February, 1959. Subscribers of the *Journal of Basic Engineering* for the fiscal year 1958–1959 will automatically receive the *Journal of Basic Engineering* and the *Journal of Heat Transfer* without additional cost during the fiscal year, inasmuch as heat-transfer papers were to have been included in the *Journal of Basic Engineering*. After the fiscal year 1958–1959 the *Journal of Heat Transfer* will be placed on a separate subscription basis as are the other four journals.

Human Factors Professional Group. A petition to establish a Human Factors Group under the Professional Divisions Executive Committee was approved.

Applied Mechanics Reviews. The Council voted to continue publication of *Applied Mechanics Reviews* under the administrative responsibility of the Publications Committee, the accounting to remain in Development Fund "A" with a policy review of the publication to be made in two years.

Machine Design Medal. Subject to final review of the Board on Honors, the Council voted to accept a deed of gift and grant of funds from the ASME Machine Design Division and to establish the Machine Design Medal as an ASME honor to be conferred annually at an appropriate meeting or conference in recognition of distinguished service in the field of machine design.

Research Agreements. The Secretary was authorized to execute certain research agreements with the California Institute of Technology (ASME Project 84-1), with Brown University (ASME Projects 84-2 and 84-3), and with Battelle Memorial Institute (ASME Project 83-1). The Secretary was authorized to sign a letter of agreement permitting the Sandia Corporation to participate in the Random Vibration Research Project to the amount of $1000.

Committees Discharged. The Committee on Procedure for Honors and the Committee on Top Management in Industry were discharged with expressions of the appreciation of the Council.

Sections. The Council approved affiliation of the Southern Tier Section with the Corning-Elmira Area Council of Scientific Societies.

ASME-EIC International Council. The President was authorized to appoint a committee to work with an equivalent committee of The Engineering Institute of Canada to revise the ASME-EIC International Council Agreement in accordance with the proposal of the Special Committee to Review ASME-EIC Relations.

Engineering Institute of Canada. It was reported that The Engineering Institute of Canada has accepted the invitation of the ASME Council to appoint a representative to attend meetings of the ASME Council without power to vote.

Engineers Joint Council. The ASME Council recommended to EJC and ECPD, and to their member societies, that, in the interests of promoting unity on a practical level, reciprocity of certain membership privileges be established.

National Transportation Policy. On May 2, 1958, the Executive Committee recommended to the Engineers Joint Council that it undertake a major study looking toward the development of a National Transportation Policy. The EJC Executive Committee on May 14, 1958, authorized its president to offer to Dr. J. R. Killian, Jr., Special Assistant to the President for Science and Technology, the services of EJC in directing a study for the establishment of such a policy.

On June 20, 1958, the EJC Executive Committee voted to submit to its participating societies information on developments to date, each interested society to be asked to nominate two members to serve on an EJC Exploratory Committee. On Oct. 3, 1958, the ASME Executive Committee nominated to EJC six individuals for consideration for such service.

President-elect G. B. Warren, on Nov. 18, 1958, wrote to E. R. Needles, president of EJC, calling attention to an editorial in the *New York Herald Tribune* of November 18, entitled, "Rockefeller and the Commuters," and he suggested that EJC offer to assist the Governors of New York, New Jersey, and Connecticut in an immediate study of transportation problems in those states. Such a study, Mr. Warren stated, would provide valuable information on which to base the long-range study which EJC agreed to undertake in the development of a National Transportation Policy.

On Nov. 26, 1958, Mr. Needles advised Mr. Warren that he was in Washington on November 25 to meet with Robert Merriam who was designated by General Persons, Administrative Assistant to President Eisenhower, to discuss ways and means by which this study can be made effective and the manner in which it can best be carried forward. He stated "We had an excellent discussion; Mr. Merriam proposes within the next week to have a meeting with Secretary Strauss, Secretary of the Department of Commerce, to get the Secretary's reactions to our suggested program. . .The proposed study is a huge subject, involving not only engineering, operation, and maintenance, but also finance, labor relations, public policy, and even politics."

Unity of the Profession. J. N. Landis and G. B. Warren were authorized to frame a resolution similar to one adopted Oct. 16, 1958, by the Board of Direction of the American Society of Civil Engineers with respect to affiliation of the National Society of Professional Engineers with both EJC and ECPD.

Norwegian Society of Engineers. Early in 1958 NSE sent to ASME, along with other societies, extracts from a timely and thought-provoking lecture by Dr. Edgar B. Schieldrop, "A Century of Fear and Hope at the Crossroads," (to be published in a forthcoming issue of MECHANICAL ENGINEERING). In October, NSE General Secretary A. Nagell sent a second communication stating, "the world today seems faced with two alternatives as to the immense power and vast store of knowledge we owe to modern science and technology, and that the general public may be said to be fairly well orientated as to the disaster foreshadowed by the alternative of war and destruction." It is stated further, that "in this situation, engineers and scientists the world over must see it as their duty to present, in some form, a comprehensible picture of the other alternative, a picture of what modern technology and science could achieve within the framework of existing possibilities." To that end the NSE is considering calling a conference of representatives from the supporting institutions in Oslo. The Council of ASME voted to refer the invitation to Engineers Joint Council with the recommendation that EJC nominate a delegate who would represent numerous engineering societies.

Certificates of Award. Certificates of Award were approved for the following persons:

Charles W. Parsons, Meetings Committee 1953–1957, chairman 1957.

Lewis K. Sillcox, retiring chairman, after 12 years' service, of the Metals Engineering Handbook Board.

John W. Brennan, Alton C. Chick, Jess H. Davis, Evan A. Edwards, Martin Goland, Clarence R. Jones, J. Kenneth Salisbury, and Theodore A. Wetzel, retiring members of the Medals Committee.

Paul V. Miller, Board on Codes and Standards.

J. Stanley Morehouse, Board on Honors.

William E. Karg, Board on Membership.

Thomas F. Perkinson, Board on Technology.

George B. Thom, Admissions Committee.

Fenton B. Turck, Finance Committee.

Glenn R. Fryling, Meetings Committee.

Henry B. Atherton, Membership Development Committee.

Dudley F. Phelps, Membership Review Committee.

William V. Chambers, National Junior Committee.

Frank L. Bradley, Organization Committee.

Paul R. Sidler, Professional Divisions Executive Committee.

Kerr Atkinson, Publications Committee.

Everett M. Barber, Research Executive Committee.

Richard G. Folsom, member, Professional Divisions Executive Committee.

Certificates were also awarded to the following retiring chairmen of Professional Divisions:

Walter Ramberg, Applied Mechanics
George T. Hayes, Aviation
Joseph C. McCabe, Fuels
Thomas J. Putz, Gas Turbine Power
Sigmund Kopp, Heat Transfer
George F. Wislicenus, Hydraulic
Rufus Oldenburger, Instruments and Regulators
John T. Bunting, Lubrication
Harold S. Sizer, Machine Design
Robert G. Hess, Management
John C. Somers, Materials Handling
John J. B. Rutherford, Metals Engineering

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

Please Print **ASME Master-File Information** Date

LAST NAME FIRST NAME MIDDLE NAME

POSITION TITLE NATURE OF WORK DONE
e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) Division, if any

*☐
EMPLOYER'S ADDRESS City Zone State

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER, e.g., Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

*☐
HOME ADDRESS City Zone State

☐
PRIOR HOME ADDRESS City Zone State

* CHECK "FOR MAIL" ADDRESS

I subscribe to *Address changes effective when received prior to:*

- ☐ Mechanical Engineering — 10th of preceding month
- ☐ *Journal of Engineering for Power*
- ☐ *Journal of Engineering for Industry*
- ☐ *Journal of Heat Transfer*
- ☐ *Journal of Basic Engineering*
- ☐ *Journal of Applied Mechanics* — (the five Journals) 20th of preceding month
- ☐ *Applied Mechanics Reviews* — 1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

☐ A—Aviation	☐ J—Metals Engineering	☐ S—Power
☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ T—Textile
☐ C—Management	☐ L—Process Industries	☐ U—Maintenance and Plant Engineering
☐ D—Materials Handling	☐ M—Production Engineering	☐ V—Gas Turbine Power
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ W—Wood Industries
☐ F—Fuels	☐ O—Lubrication	☐ Y—Rubber and Plastics
☐ G—Safety	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ H—Hydraulics	☐ Q—Nuclear Engineering	
☐ I—Human Factors Group	☐ R—Railroad	

William E. Shoupp, Nuclear Engineering

William R. Sanborn, Power

Leo J. Ricond, Process Industries

Ford H. McBerty, Production Engineering

Frank L. Murphy, Railroad

Robert W. Barber, Rubber and Plastics

H. Edgar Beaven, Safety

Nathaniel M. Mitchell, Textile Engineering

Robert H. Moore, Maintenance and Plant Engineering Executive Committee.

Certificates were awarded to Frank J. Fontana, past-chairman, Southern California Section, and Lewis Conta, past-chairman, Rochester Section; also to the following retiring chairmen of Sections: A. G. Long, Arizona; W. A. Shellgrove, Atlanta; Robert Cornish, Canton-Alliance-Massillon; John R. Lowe, Jr., Cleveland; M. C. Pannell, East Tennessee; J. K. Whitfield, Eastern North Carolina; F. H. Bayha, Fort Wayne; W. A. Pollock, Milwaukee; Bertram Getsug, Minnesota; Hugh T. McGill, Nebraska; Austin C. Thies, Piedmont Carolina; Richard Boutros, Rochester; Shuman H. Moore, Southern California; William B. Nordquist, Western Washington; and Mrs. P. B. Baker, Nashville Subsection of the Chattanooga Section.

Deaths. The Council noted with regret the deaths of Charles F. Kettering and Robert F. Throne.

Appointments. The following presidential appointments were noted: University of Tampa, Tampa, Fla., inauguration of president, Dec. 13, 1958, John C. Reed; ASME-ASLE Joint Lubrication Conference, Oct. 13–16, 1958, E. O. Bergman; University of Southern California, inauguration of president, Oct. 23, 1958, J. Calvin Brown; and Elmer A. Sperry Award Dinner, Nov. 1, 1958, W. H. Byrne.

Power Test Codes. Extension was authorized of Rawleigh M. Johnson's term as chairman of the Power Test Codes Committee for one year. Mr. Johnson will represent the Committee on the Board on Codes and Standards for that same period.

Actions of 1959 ASME Council

The organization meeting of the 1959 Council of The American Society of Mechanical Engineers was held on Dec. 1, 1958, at the Statler Hilton Hotel, New York, N. Y. The retiring President, J. N. Landis, called the meeting to order and introduced the new members of the Council.

Present at the meeting were: James N. Landis, President 1958, and Glenn B. Warren, President 1959; past-presidents and members of the 1959 Council, J. W. Barker and W. F. Ryan; other past-presidents, F. S. Blackall, jr., A. G. Christie, D. W. R. Morgan, E. W. O'Brien, R. J. S. Pigott, and A. A. Potter; Vice-Presidents of the 1959 Council, E. W. Allardt, H. S. Aurand, C. H. Coogan, Jr., T. J. Dolan, Harold Grasse, G. R. Hahn, J. W. Little, and A. W. Weber; retired Vice-Presidents W. H. Byrne, J. H. Sams, C. H. Shumaker, and R. S. Stover; directors of the 1959 Council, Everett M. Barber, E. O. Bergman, R. G. Folsom, E. W. Jacobson, A. M. Perrin, Joseph Pope, L. N. Rowley, R. B. Smith, and V. W. Smith; retired directors, H. C. R. Carlson and G. A. Hawkins; E. J. Kates, treasurer; O. B. Schier, II, secretary; C. E. Davies, secretary-emeritus; T. A. Marshall, Jr., senior assistant secretary; D. C. A. Bosworth, W. E. Letroadec, W. E. Reaser, S. A. Tucker, J. D. Wilding, assistant secretaries; and H. I. Nagorsky, controller.

Mr. Landis presented the President's Gavel to Mr. Warren who took the chair and called the meeting to order.

Past-president receives special pin. The Council expressed to James N. Landis, retiring President, sincere appreciation and thanks for his outstanding accomplishments during his administrative year, during which he attended many meetings of the Sections, Student Sections, National Meetings, Professional Division Conferences, and other meetings of the Society and sister organizations. Past-president Ryan presented the President's pin to Mr. Landis.

Tribute to Deceased Members. President Warren requested A. G. Christie to pay tribute to Dr. William F. Durand, past-president and Hon. Mem. ASME, who died on Aug. 9, 1958. E. G. Bailey paid tribute to Charles F. Kettering, Fellow ASME and Honorary Chairman of the Member-Giving Campaign, who died on Nov. 25, 1958. President Warren paid tribute to Robert F. Throne, who died on Nov. 8, 1958.

Ernest Hartford and D. C. A. Bosworth. President Warren, on behalf of the Council, expressed sincere appreciation to Ernest Hartford, Mem. ASME, for 48 years of service to the Society and the engineering profession, and to D. C. A. Bosworth for 23 years of service to the Finance Committee, the Council, and members of the Society.

Retiring Members of the Council. Retiring members of the Council expressed appreciation of the opportunity they had enjoyed in serving the Society. They were: D. W. R. Morgan, past-president; W. H. Byrne, James H. Sams, Rolland S. Stover, and C. H. Shumaker, Vice-Presidents, and H. C. R. Carlson and G. A. Hawkins, directors.

Appointments. The Council made the following appointments:

O. B. Schier, II, secretary of the Society for the year ending Nov. 30, 1959.

Thomas A. Marshall, Jr., senior assistant secretary in charge of Technological Services.

W. E. Reaser, assistant secretary in charge of Field Service.

Stanley A. Tucker, assistant secretary and Publications Business Manager.

John D. Wilding, assistant secretary in charge of Codes and Standards Service.

Walter E. Letroadec, assistant secretary in charge of Personnel and Office Service.

Harold I. Nagorsky, controller.

Edgar J. Kates, treasurer.

Harry J. Bauer, assistant treasurer.

Edgar J. Kates, treasurer of the Development Fund.

Executive Committee of the Council. The Executive Committee of the Council for 1959 will consist of: G. B. Warren, chairman; E. W. Allardt; L. N. Rowley; R. B. Smith; and A. W. Weber.

Council Member Appointed. Everett M. Barber was appointed to serve as director to fill the unexpired term of Glenn B. Warren.

Assignments to Boards and Committees. The following assignments to Boards and Committees were made: Board on Codes and Standards, E. O. Bergman and Louis Polk; Board on Education, R. G. Folsom; Board on Honors, V. Weaver Smith; Board on Membership, L. N. Rowley; Board on Public Affairs, A. M. Perrin; Board on Technology, R. G. Folsom, E. W. Jacobson, R. B. Smith, and E. M. Barber; Finance Committee, Joseph Pope and W. F. Ryan (to replace D. W. R. Morgan); Organization Committee, V. Weaver Smith, C. H. Shumaker (2-year term to replace C. B. Peck), and Thompson Chandler (1-year term to replace W. F. Ryan).

Council Committee on Staff Personnel. The Council Committee on Staff Personnel will consist of the following: W. F. Ryan, chairman; F. L. Bradley, A. C. Pasini, V. Weaver Smith, J. N. Landis, A. W. Weber, and G. B. Warren, President, *ex-officio*.

Special Committees of the Council. The Council voted to continue certain special committees and to discharge with thanks and appreciation the Applied Mechanics Reviews Managing Committee.

Delegation of Authority to Boards. Certain functions were delegated to the following Boards for the period of one year: Board on Technology, Board on Codes and Standards, and Board on Honors.

Engineering Index. The present Contract with the Engineering Index, Inc., was extended for the year 1959.

The Institution of Mechanical Engineers. William Van Note, president, Clarkson College of Technology, was designated Honorary Vice-President to represent ASME at the Zurich meeting of The Institution of Mechanical Engineers, June 29, 1959.

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

The application of each of the candidates listed below is to be voted on after Feb. 25, 1959, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and •Transfers

Alabama

Ellis, William C., Mobile
Hall, Max W., Florence
•Wuska, Andrew T., Birmingham

California

Cumming, John B., Modesto
Danielson, Duane H., San Lorenzo
Henderson, William C., Los Angeles
Hwang, Chintsun, Hawthorne
Kroebig, Helmut L., El Segundo
Kummli, Paul, Los Angeles
La Berge, Pierre R., San Diego
Needham, William S., Alamo
•Rubinstein, Herbert J., Los Angeles
Sprague, Stephen B., Santa Clara

Connecticut

Don, Jules M., Naugatuck
Flessa, Fred W., Cheshire
Johnson, Richard W., Stamford
Lennox, George C., Southbury
Schulze, Leonard J., Stepney Depot
Vitali, Vincent J., Jr., Wallingford

District of Columbia

Husain, Mazhar, Washington, D. C.
Liljelund, Ralph J. H., Washington, D. C.

Florida

DeMarch, Joseph A., Merritt Island
Emery, Hervey R., Jr., Jacksonville

• Transfer to Member or Affiliate.

HORBAN, GERALD J., Miami

Georgia

DEARING, DONALD R., Augusta

Hawaii

BRIANT, WALTER L., JR., Kaneohe, Oahu

Illinois

AZIZ, ABDUL, Evanston
DASKAL, GEORGE H., JR., Harvey
DAVIS, EDWARD L., Chicago
HAMILTON, J. HARRY, Chicago
JANICKE, MARION J., Chicago
PANKO, WILLIAM J., Harvey
SCHUSLER, RICHARD M., Peoria
THASSY, MICHAEL G., Chicago
WEACHTER, HAROLD L., Peoria

Indiana

FOSTER, JOHN R., Indianapolis
FUNG, SUI A., Evansville
MCCULLUM, JAMES R., Richmond

Louisiana

•SCHLUTER, JOHN H., New Orleans

Massachusetts

BLACK, THOMAS J., North Andover
CROW, THOMAS S., Fitchburg
•GOVONI, WALTER J., Springfield
KYROS, WILLIAM, Wilmington
NECE, RONALD E., Cambridge
SIEGEL, NOEL S., Watertown
•STERN, HANSJOERG, Topsfield
SWEET, FRANCIS A., JR., North Easton
WHITNEY, WALTER B., Needham

Michigan

SILVAGI, JOSEPH, Detroit
SOVRAN, GINO, Royal Oak
WOCHOLSKI, LEONARD B., Clio

Missouri

•DODSON, ROWLAND W., St. Louis
•FISHERKELLER, JOHN J., JR., Kansas City
LARRIGAN, HARRY J., St. Louis

Montana

ZADERENKO, SERGIO G., Butte

Nebraska

BROWN, RALPH H., Omaha
REES, HAROLD, Omaha

New Jersey

BANACH, HENRY J., Pompton Plains
CIALLELLA, ANTHONY C., Union
JACKSON, A. MILTON, Wyckoff
KLAENTSCHI, MAX J., Princeton
LYNCH, ROBERT B., Linden
SHERMAN, AWID A., Highland Park

New York

•BARAN, WILLIAM, Niagara Falls
BURGER, LEWIS J., Schenectady
CLEVELAND, JOHN O., Seaford
GALLO, JULIUS R., Brooklyn
GLAESER, FREDERICK G., Yonkers
HENDRICKS, DANIEL E., JR., New York
LIGATO, MARTINO F., Olean
LOWN, HAROLD, Syracuse
MATIN, SHAIKH A., New York
•MAY, REESE W., New York
•NICKERSON, ROBERT D., New York
ORTHWEIN, WILLIAM C., Owego
OSLER, RICHARD L., New York
PRIOR, THOMAS E., Brooklyn
ROSE, RONALD, Oceanside
ROSENSTEIN, MORTON, Brooklyn
RUSSELL, LOUIS M., Corona
SCHOEN, DONALD F., Brooklyn
TREGO, JAMES W., Tonawanda
WEEKS, LARRY J., Wellsville
WEITZ, HAROLD, New York
WOLF, JOHN H., JR., Kenmore

North Carolina

BALCH, RALPH H., Charlotte
RIDGE, PAUL E., Jacksonville

Ohio

•ALFORD, LYNN O., JR., Cincinnati
BIRO, GEORGE L., Youngstown
EICHENBERGER, HANS P., Cleveland
FARR, JAMES R., Wadsworth
GOODWIN, ERNEST G., JR., Toledo
HENNESSY, JOHN J., Youngstown
HUNSAKER, ORAL K., Dayton
LAWRENCE, EVERETT M., Barberton
NEWMAN, JOHN, Cleveland
RITCHIE, MALCOLM L., Dayton

Oklahoma

WAMSLEY, STUART M., Bartlesville

Pennsylvania

ABRIBAT, MARC G., Philadelphia
BENEDICT, ROBERT P., Lester
DEVINE, ROBERT F., Pittsburgh
GLATTER, JACOB, Pittsburgh
HENFEY, ALBERT E., Philadelphia
KENDIG, CALVIN F., Philadelphia
PILLING, STANLEY L., West Chester
WHITNEY, PETER H., Erie
WOODBURN, WILTON A., JR., New Kensington

South Carolina

•THOGERSEN, BJORN, Camden

Texas

AMERMAN, JACK A., Houston
HOWLE, CLARENCE E., Dallas
JACK, WILLIAM C., Dallas
MCINTOSH, GEORGE B., JR., Houston
PHILLIPS, EDWIN L., JR., Odessa
SWINSON, WELDON F., Lubbock

Virginia

WEBER, THOMAS E., Falls Church

Washington

BUSH, EUGENE L., Bellevue
•STILES, STANLEY L., Spokane

West Virginia

•WARNER, DONALD S., Charleston

Wisconsin

SCHACHTE, JOHN J., Milwaukee

Foreign

DEAGUE, GEOFFREY A., Birmingham, England
FULLER, LOUIS, London, England
GRODECKI, GEORGE, Toronto, Ont., Canada
HAMMOND, JOHN R., JR., Balboa Heights, Canal Zone
HUCKE, JOSE B., São Paulo, Brazil, S. A.
JONES, ELWYN J., Mexico, D. F., Mexico
PAGE, GARNET T., Montreal, Que., Canada
•RAMACHANDRAN, ARCOT, Bangalore, India
TOOGOOD, GEORGE D., London, England
YAO, YOU YUAN, Taiwan, Formosa, China

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC [Agency]

THESE items are listings of the Engineering Societies Personnel Service, Inc. This Service, which co-operates with the national societies of Civil, Electrical, Mechanical, and Mining, Metallurgical, and Petroleum Engineers, is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

If you are interested in any of these listings, and are not registered, you may apply by letter or résumé and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 5 per cent of the first year's salary if a nonmember, or 4 per cent if a member. Also, that you will agree to sign our placement-fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application to the employer and for returning when possible.

A weekly bulletin of engineering positions open is available at a subscription rate of \$3.50 per quarter or \$12 per annum for members, \$4.50 per quarter or \$14 per annum for nonmembers, payable in advance.

NEW YORK	CHICAGO	SAN FRANCISCO
8 West 40 St.	84 East Randolph St.	57 Post St

Men Available[1]

Mechanical Engineer, BSME; 40; experienced in plant construction and maintenance (chemical) six years; municipal-type engineering, seven years; capable writer, editor, speaker. Prefers Middle Atlantic, Great Lakes area. Me-678.

Chief Industrial Engineer, BS, Yale, 1931, postgraduate work at NYU; 50; experienced in the supervision of time study, rate setting, incentive systems, cost estimating and analysis, production analysis, job evaluation, wage administration, personnel. Prefers New England. Me-679.

Director of Engineering, BSME; 25 years' experience as director of engineering, chief engineer, administrative engineer, in charge of design R&D laboratory; chief sales engineer. Prefers Midwest or East. Me-680-922-Chicago.

Stainless-Steel and Heat-Resistant Alloy Specialist, BS in Metallurgy; 39; 20 years' metallurgical-engineering experience; includes consulting, teaching, and practical mill experience. Location optional. Me-681.

New Product Liaison Between Sales and Engineering, BME; 37; 12 years' general industrial background covering manufacturing, design, and sales. Resourceful and creative. Prefers East. Me-682.

Chemical Engineer, BS(ChE); 34; three and one half years process design and start-up, six years instrumentation sales, two and one half years plant engineering. Desires project-engineering responsibility with company expanding existing facilities or constructing new plants. Will relocate as required. Me-683.

Sales or Engineering Executive, BS(ME), BS(EE)MS; 46; broad sales and engineering experience in heavy industry, mill machinery, and electrical and metal-industry operations. Will locate anywhere in U. S. or abroad. Me-684.

Senior Engineer, ME, MS, PE,; 40; 20 years' experience heat power and heat transfer, steam-jet ejector specialist; rate, design, and price. Condensers, coolers, heaters (including high-pressure feedwater) for power and process plants. Sales engineer; prepare sales proposals and advertising literature. Prefers New York metropolitan area. Me-685.

Mechanical Engineer, BSME; 37; project engineer, oil refineries, chemical plants, power plants, flow sheet to final design, equipment, heat balance, heat transfer, fluid flow, thermodynamics, ten years' experience. Prefers eastern United States. Me-686.

Plant Engineer, BSME; 37; 14 years' diversified plant-engineering experience in large rubber manufacturing plant. Licensed stationary engineer, N. J. Desires challenging career position. Prefers New York metropolitan area; will negotiate relocation. Me-687.

Junior Engineer, Heating, Ventilating, Air Conditioning, BME; 23; design, layout, estimating, heating, ventilating, air conditioning, and plumbing. Prefers East. Me-688.

Senior Project Engineer, BSc, Std.; 37; five years' engineering apprenticeship; 11 years' experience design, organization, and management of major chemical and refinery plant. American and European standards. Prefers Northwest Coast, British Columbia. Me-433.

Positions Available

Manufacturing Manager for company manu-

[1] All men listed hold some form of ASME membership.

facturing lighting equipment. Must be experienced in sheet-metal finishing and forming and be strong in production control. Will have 400 employees under supervision. $20,000–$25,000. New York metropolitan area. W-6818.

Technical Secretary for a trade association; prefer recent graduate mechanical engineer who has completed military obligations. Excellent opportunity for professional development and advancement. Best working conditions, fringe benefits. Considerable travel. Salary open. East. W-6824.

National Sales Manager, preferably graduate mechanical, for company manufacturing electronic automation equipment. Some experience in the automobile industry desirable or experience in the heavy conveyer or material-handling equipment fields. $15,000–$20,000. Midwest. W-6830.

Design Engineers, Machine Pressure-Vessel Cement Kiln, considerable experience in this field. Top salaries, no income taxes; one-month paid vacation per year; paid transportation for applicants and family. Apply by letter giving complete résumé including salary desired. Caribbean area. F-6832.

Field Editors for Trade Publication. (*a*) Graduate mechanical engineer, approximately five years' experience in aircraft-design work. Need not have previous editorial experience. $8000–$10,000. (*b*) Graduate mechanical engineer, five to eight years' experience in machine tool, heavy rolling mills, or other steel-industry design experience. Need not have previous editorial experience. $10,000–$12,000. Ohio. W-6841-C.

Chief Engineer, mechanical graduate, design, product engineering, tooling, and production experience covering porcelainized stamping and foundry products. $15,000. South. W-6855.

Chief Engineer experienced in the manufacture of FHP motors. This is a newly created position in line with company expansion. $20,000–$25,000. Midwest. W-6880.

Mechanical Design Engineer, graduate mechanical, specialization in mechanical design, minimum of five years' experience of which at least two should have been on the drafting board doing actual design. Should have knowledge of shop practice including turning, milling, boring, and grinding. Should understand the design of bearings, castings, cams, gearing, slides, lubrication, and other miscellaneous mechanical components. Will work as project engineer responsible for an entire project. To $11,000. Company will pay placement fee. N. Y. State. W-6884.

Director of Engineering, preferably mechanical, to take charge of over-all engineering activities, encompassing mechanical, civil, research, and development. Major emphasis on the development of improved equipment for field operations in the heavy construction field. Very attractive salary. New York, N. Y. W-6885.

Assistant Chief Engineer, Mining, graduate in mining, civil, mechanical, or metallurgical engineering, at least five years' experience in mining or metallurgical operations, in structural design, stress analysis, and layout. Thorough knowledge of management of technical employees required. Must have ability to design, develop, and supervise the construction of production, control, and maintenance facilities for mine, mill, and community management departments. Salary commensurate with experience and ability. Mountain States. W-6886.

Production Manager to manage all production aspects of an electronics-manufacturing concern doing wiring, assembly, and test of electronic equipment; also sheet-metal fabricating, plating, and paint shop. Knowledge of product control, costs, tooling, military inspection necessary. $9000–$12,000. Western Pa. W-6895.

Engineers. (*a*) Senior engineer, project, graduate; for jet-nozzle design; should have four to five years' experience on either hydraulic or fluid flow, spray nozzles, valve design, instruments, or hydraulic mechanisms. $8000–$10,000. (*b*) Engineer, experienced as afore-mentioned $6000–$8000. Company will negotiate fee and relocation expenses. Central N. Y. State. W-6900.

Chief Manufacturing Engineer, Hardware Division, graduate mechanical, about 15 years of engineering experience. Supervisory engineering experience in an organization with at least 1000 employees; expert knowledge of punch-press tooling, including progressive dies; some experience with process determination in metal fabrication employing primarily punch presses but also dealing with machining operations. $10,000–$15,000. Conn. W-6901.

Engineers. (*a*) Mechanical engineer, engineering degree, about 15 years' experience, to supervise engineering department of manufacturer of power boilers. Must be thoroughly familiar with all the mechanical-design problems and calculations. Duties will include close supervision of layout men, detailers, and checkers. (*b*) Chief design engineer, engineering degree, to take charge of design department for the manufacture of power boilers. Thorough knowledge of heat transfer and fluid flow essential. Must have extensive background in this field. Salaries open. Placement fees and moving expenses negotiated. East. W-6918.

Engineers. (*a*) Senior machine designer, eight to ten years of machine design, in field of metal-processing machinery, and background in machine-tool design, packaging and closure machine, to study and evaluate methods of manufacturing heat-transfer surfaces of all types. (*b*) Development engineer, BS or MS in mechanical or chemical engineering; five to eight years' industrial or research experience, preferably in fields of fluid flow and heat transfer, to study and evaluate heat-transfer surface and corresponding equipment designs. $8500–$10,000. (*c*) Engineering manager, BS or ME in engineering, ten to 12 years' industrial-research experience, preferably in fields of machine design, heat transfer, or fluid flow. Will be responsible for all engineering activities having to do with heat-transfer equipment, including personal direction of all machine design for production machinery and supervision of development engineering on new heat-transfer surface. $11,000–$13,000. N. Y. State. W-6929.

Power and Plant-Engineering Supervisor, mechanical or electrical graduate, preferably with license, and at least five years' power and plant-engineering experience in food or allied fields covering primary and secondary electrical distribution systems, automatic process controls, materials handling, packaging, heating, ventilating, and air conditioning. $8000–$12,000. New York, N. Y. W-6933.

Sales Engineer, mechanical graduate, experience in the gas-utility field covering meter equipment. Will work three to four months as an application engineer in factory meter-sales department. Will then become field engineer specializing in meter sales. $5280–$8500. Midwest. W-6936.

Instructor or Assistant Professor in the area of machine design and mechanics. Salary and rank dependent upon training and teaching experience. Consulting opportunities; graduate opportunities. Available September, 1959. Upstate N. Y. W-6940.

Design Engineers, degree in engineering, eight years' experience, including four years in responsible position, for design, layout, drafting, and writing specifications for heating, ventilating, and air-conditioning systems for buildings. Should have an interest in plumbing, electrical and sprinkler trades as well as in heating, ventilating, etc. About $7500. Maine. W-6941.

Design Engineers, mechanical graduates, design and layout experience covering heating, ventilating, air conditioning, refrigeration, and plumbing. Salary open. PE license desirable. Va. W-6942 (*a*).

Chief Engineer, mechanical or civil-engineering graduate, at least ten years' supervisory project-design engineering and construction experience in combustion-equipment fields. $15,000. New York, N. Y. W-6945.

Industrial Engineer, IE or ME degree, time-study, plant-layout, and general experience in the management field. Will also work in plants of clients. Must be high caliber with good personality. Headquarters, New York, N. Y. W-6952.

Research and Development Engineer, mechanical, at least two years' experience in product development on ferrous castings, pressure vessel and/or hydraulic equipment. About $8000. Employer will pay placement fee. Kan. or Neb. C-6840.

Administrative Assistant to Chief Engineer, preferably graduate mechanical, electrical, or metallurgical engineer, at least ten years' supervisory experience in design, estimating, or operation phases of metal-mine plants, mills, concentrators, smelters, or refineries. Will be responsible for engineering-department personnel, cost control, and special assignments or studies. $12,000–$14,000. Western U. S. S-3967-R.

Industrial Engineer, Chain Store, IE or equivalent, eight to ten years' experience in time study, method analysis, stores and warehouse layouts, industrial operations and relations (preferably but not necessarily related to large merchandising operations). Well-balanced individual with initiative and capable of providing support to management and liaison from management to operations. Will be management-staff engineer working with managers of stores, warehouses, plants and construction, maintenance, and operating divisions of large chain-food store. To $10,000. Headquarters, San Francisco Peninsula. S-3990-R.

Junior Engineers, Airport, Waterfront, mechanical and electrical; recent graduates to five years' experience in engineering office, including drafting, checking plans, assisting in specifications, costs, quantities, inspection. Should be able to prepare office-cost records. Mechanical work will consist of heating, ventilating, pipe, and related equipment. $6000–$7200, depending on experience. Position is with a municipality. San Francisco East Bay. SG-3996.

Manager, Product Development, Instruments, minimum of BS, preferably in mechanical engineering. Strong on mechanical design and familiar with photometric techniques, good foundation in basic sciences required. Several years' experience in project engineering and able to direct engineering effort. Responsible for direction of product design and development program for company producing complex medical research instruments. Supervise department of 15 to 25 including mechanical, electronic engineers, technicians, draftsmen, model makers. $11,500–$15,000. San Francisco Peninsula. S-4009.

Design Engineers, Consultant, mechanical, electrical, or civil, with experience equivalent required for registration for: (*a*) Mechanical engineering, plumbing, heating and ventilating, air conditioning. (*b*) Electrical engineering, industrial and commercial power distribution and controls. (*c*) Civil engineering, water supply, drainage, and sanitary problems. $7800–$8400. San Francisco, Calif. S-4027.

Designer, Mechanical Structures, mechanical or civil, emphasis on structural design of mechanical components of remote controlled, special handling devices. Requires knowledge of mechanics of materials, universal joints, etc. $7800–$8400. Ore. S-4031.

Sales Trainee, Construction Equipment, preferably graduate civil or mechanical, or equivalent background, two to five years' sales experience desired although not necessary. Two to three months basic training in various departments of company. Will then be assigned to sales of parts and accessory lines in the field under senior salesman and distribution sales managers. Must be willing to relocate in northern Calif. or western Nev. $4800, straight salary, to start. S-4038.

Chief Engineer, Petroleum, mechanical, electrical, or civil graduate, plus advanced work in petroleum engineering. Requires experience as chief or assistant chief engineer or chief project engineer in charge of large engineering projects; able to plan and organize engineering projects and provide direction for design, construction, and maintenance of facilities—power plants, oil transportation, and storage. Will be senior technical adviser to vice-president and general manager. $18,000–$20,000; two-year contract renewable. Persian Gulf. S-4040.

Sales Engineer, Water Heaters, mechanical training, solid experience selling mechanical equipment to engineers, jobbers, state, and city (direct-fired water heaters, all sizes). Developed territory, long-established lines. Good opportunity for capable salesman. Potential, $8400–$12,000. San Francisco Bay area. S-4043.

Sales Engineer, Prestressed, engineering background; will consider limited experience or well-experienced sales engineers who have worked with architects, engineers, contractors, county, bridge, or public bodies, engineers in engineering departments, construction divisions, and field. To approach enthusiastically the problem of developing a clientele for precast and prestressed concrete members. $6600–$9600, to start, depending on experience. San Francisco headquarters, cover northern and central Calif. S-4046.

Mechanical Designers, Research and Development, MS or PhD, experience in mechanical design, theoretical and applied mechanics, aerodynamics, aeroballistics, hi vacuum, heat transfer, fluid mechanics, reactor-control systems, and gadgets. Must be U. S. citizens. To $10,800. San Francisco East Bay. S-4050-R.

Sales Engineer, Pumps, engineering education, preferably mechanical some experience proving capability as salesman. Will work for distributor of pumps and compressors. Opportunity to acquire interest. $6000, plus commission and expenses. San Francisco. S-4060.

OBITUARIES

Lloyd Felch Bayer (1893–1958), retired, vice-president, Tidewater Oil Co., San Francisco, Calif., died Sept. 29, 1958. Born, Mount Vernon, N. Y., Oct. 26, 1893. Education, BS(ME), Stevens Institute of Technology, 1914. Assoc. Mem. ASME, 1915; Affiliate ASME, 1922; Mem. ASME, 1935. Mr. Bayer had been with Tidewater and its predecessor companies since 1916. He was a member also of ASTM, and a

past-officer of the American Petroleum Institute.

Willard Lacy Case (1876–1958), associate, George S. Armstrong & Co., Inc., New York, N. Y., died Sept. 22, 1958. Born, Elizabeth, N. J., Oct 23, 1876. Education, AB, Brown University, 1896; CE, Columbia University, 1901. Mem. ASME, 1932. Mr. Case had been with the Armstrong firm since 1938. He was the author of a book "Factory Buildings." He served with the Fifth U.S. Cavalry in the Spanish-American War. Among his many positions, Mr. Case had been treasurer and director of Yale & Towne Manufacturing Co., and vice-president and director of Turner & Seymour Manufacturing Co.

William Darbee (1875–1958?), whose death recently was reported to the Society, had, before his retirement, been an executive, Electric Bond & Share Co., New York, N. Y. Born, Brooklyn, N. Y., Sept. 12, 1875. Parents, William H. and Sarah I. Darbee. Education, ME, Stevens Institute of Technology, 1897. Married Sarah C. Putsche, 1908. Assoc. Mem. ASME, 1900; Mem. ASME, 1912. Prior to his retirement, Mr. Darbee had been with Electric Bond and Share since 1911. Member also of AIEE. He was a registered professional engineer in New York State, 1935.

Erik Floor (1891–1958), founder and president, Erik Floor & Associates, Inc., Chicago, Ill., died July 13, 1958. Born, Copenhagen, Denmark, June 25, 1891. Education, EE, University of Copenhagen, 1912. Mem. ASME, 1945. A specialist in the field of hydroelectric generation, Mr. Floor was associated with the late L. F. Harza, 1921–1945, as chief electrical engineer; and after 1934, as vice-president and chief engineer of the Harza Engineering Co. In 1945 he formed the firm which bears his name. Member also AIEE.

James Garland (1871–1957), general superintendent, Dominion Engineering Co., Ltd., Montreal, P.Q., Canada, died Aug. 25, 1957. Born, Providence, R. I., Nov. 20, 1871. Parents, James and Emma Garland. Education, attended St. Luke's College. Married Myra Smale, 1900. Mem. ASME, 1921. Mr. Garland had been general superintendent at Dominion Engineering since 1919.

Joseph Giordano (1900–1958), layout draftsman, Aviation Division, Machine & Tool Design Co., Philadelphia, Pa., died October, 1958. Born, Marseilles, France, Feb. 22, 1900. Parents, David and Angelina Giordano. Education, attended Villanova and Drexel Colleges. Naturalized U. S. citizen, Philadelphia, Pa., 1931. Mr. Giordano held a number of U. S. Patents. Assoc. Mem. ASME, 1956. Survived by his widow, Josephine Giordano.

Alfred Lawrence Glaeser (1900–1958?), power engineer, Hercules Powder Co., Inc., Wilmington, Del., died recently according to a notice received by the Society. Born, Brooklyn, N. Y., March 2, 1900. Education, ME, Stevens Institute of Technology, 1924; attended Columbia University. Mem. ASME, 1946. Mr. Glaeser had been with the Hercules Powder Co. since 1937. He held two patents—one for a cracking furnace and the other for a special wood-burning furnace. He was selected "engineer of the year" by the ASME Delaware Section and received the Society's 75th Anniversary Medal. His services to the Society on behalf of his Section were extensive and included: action which led to the formation of the Wilmington Subsection; vice-chairman and chairman, Subsection; member, Executive Committee, Delaware Section. He was a member also of Tau Beta Pi.

George Henry Hauser (1896–1958?), whose death recently was reported to the Society had been vice-president, Liberty Aircraft Products Corp., Farmingdale, L. I., N. Y. Born, Hicksville, N. Y., March 9, 1896. Parents, George and Gertrude (Wang) Hauser. Education, BS(ME), New York University, 1917; hon. LLD, 1950. Assoc. Mem. ASME, 1918; Mem. ASME, 1931. Married Mildred Hannah Armstrong, 1922; children, George H. and Ruth. Mr. Hauser had been with Liberty Aircraft since 1938. He was also a director of the Banks of Hicksville and of Suffolk County and he was director and vice-president of The First National Bank of Mineola. He had been a member of IAS, SAE, and AIEE. He was a member also of Pi Tau Sigma.

Charles Bernard Irmer (1896–1958), engineering staff, Leeds & Northrup Co., Philadelphia, Pa., died Oct. 9, 1958. Born, Philadelphia, Pa., Jan. 12, 1896. Parents, Charles B. and Margaretta M. Irmer. Education, BS(ME), University of Pennsylvania, 1918; ME, 1929; postgraduate study at U. S. Navy Steam Engineering School, 1918; and Temple University. Married Christina K. Fyfe, 1936. Assoc. Mem. ASME, 1919; Affiliate ASME, 1925; Mem. ASME, 1935. Mr. Irmer had been with Leeds & Northrup since 1930. During World War I, he served as an ensign in the U. S. Navy. Early in his career he taught mechanical drawing and machine design at the University of Pennsylvania. He was the author of several papers published in the technical press. He held patents for a chemical-feeding device and a hydraulic drive mechanism. Survived by his widow.

Richard Theodor Lang (1879–1958), retired, technical director, J. M. Voith, GmbH, Maschinenfabrik, Heidenheim a.d. Brenz, Germany, died Sept. 12, 1958. Born, Heilbron, Neckar, Germany, Nov. 18, 1879. Education, Regierungsbaumeister, Technical High School of Stuttgart, 1907. Mem. ASME, 1949. Mr. Lang joined the Voith concern in 1901. From 1923 to 1928 he was general manager of the American Voith Contact Co. He became director of the German company in 1930 and, in 1950, joint managing director. He retired in 1952. In appreciation of his outstanding merits in connection with the development of paper-making machines, the Technical High School of Stuttgart in 1953 conferred upon him the title of honorary senator. He held numerous patents in the U. S., Canada, England, and Germany; and was the author of several papers published in the technical press. Member also of TAPPI and Verein deutscher Ingenieure.

Harry Louis Leyda (1897–1958?), manager, steel plate sales, Lone Star Steel Co., Dallas, Texas, died recently according to a report received by the Society. Born, Franklin, Pa., March 19, 1897. Parents, Cyrus Frederick and Ella Jane (Graham) Leyda. Education, attended University of Chicago, 1915–1916. Married Helen Gabrielle Brown, 1926. Mem. ASME, 1937. Prior to his association with the Lone Star Co., Mr. Leyda had held executive posts with Fort Worth Structural Steel Co., and General Steel Co.

Francis Benjamin Northrup (1878–1958?), whose death recently was reported to the Society had been retired, and was formerly with Howe Machinery Co., West Milton, Ohio. Born, Washingtonville, N. J., March 4, 1878. Parents, Frances B. and Miranda E. (Phillips) Northrup. Education, Newark Technical School and ICS. Married Viola Bowers, 1906; children, Viola, Alice, and Francis. Assoc. Mem. ASME, 1905; Mem. ASME, 1916.

Claud Henry Orr (1888–1958), engineer, National Carbon Co., Inc., Cleveland, Ohio, died Oct. 18, 1958. Born, Muncie, Ind., Dec. 31, 1888. Education, ME, Purdue University, 1913. Assoc. Mem. ASME, 1919; Mem. ASME, 1926. Mr. Orr joined National Carbon in 1919. He spent many years traveling throughout the world and had been stationed in India and Mexico with the firm. He retired in 1956. Survived by his wife, Dorothy.

James T. Potter (1904–1958), manufacturer's representative, Charlotte, N. C., died Sept. 18, 1958. Born, Lexington, Ky., Jan. 3, 1904. Parents, James T. and Dora C. Potter. Education, studied industrial chemistry, University of Kentucky; and chemical engineering, University of Alabama. Married Martha E. Mays, 1931; Children, Martha Ann and James T, III. Mem. ASME, 1954. Mr. Potter was a specialist on boiler-water conditioning and had written various papers on the same subject. He had served as a vice-chairman of the Piedmont-Carolina Section and on its Membership Committee. Survived by his widow.

Herman Andrew George Scherer (1894–1958?), chief engineer, Ivers-Lee Co., Newark, N. J., died recently according to a notice received by the Society. Born, Newark, N. J., May 8, 1894. Education, Newark Technical School, 1918. Assoc. Mem. ASME, 1919; Affiliate ASME, 1922; Mem. ASME, 1927. Mr. Scherer had been with Ivers-Lee since 1919. He was a member of the American Ordnance Association. He had published articles in *Machinery* and *Iron Trade Review.*

Fred R. Shedd (1899–1958), executive vice-president, Ohio Valley Electric Corp., Chillicothe, Ohio, died Oct. 22, 1958. Born, Niagara Falls, N. Y., Sept. 28, 1899. Education, attended University of Michigan. Assoc. Mem. ASME, 1931; Mem. ASME, 1935. Mr. Shedd had been active in electric-utility management and power-plant operations for 39 years, having served with Indiana & Michigan Electric Co., Appalachian Power Co., Atlantic (N. J.) Electric Co., and the American Electric Power Co. Survived by his widow, the former Jean Hessin.

Claude Hoffman Sterling (1890–1958), retired executive mechanical engineer, Kenosha, Wis., died Sept. 11, 1958. Born, Chicago, Ill., Sept. 11, 1890. Parents, John and Franke Sterling. Education, Armour Institute of Technology. Married Isabelle J. McConnell, 1913; son, C James. Assoc. Mem. ASME, 1916; Affiliate ASME, 1919; Mem. ASME, 1923. Retired in 1945, Mr. Sterling had been with General Motors Corp. for 25 years. He held nine U. S. Patents pertaining to automotive construction. Survived by his widow, son, and four grandchildren.

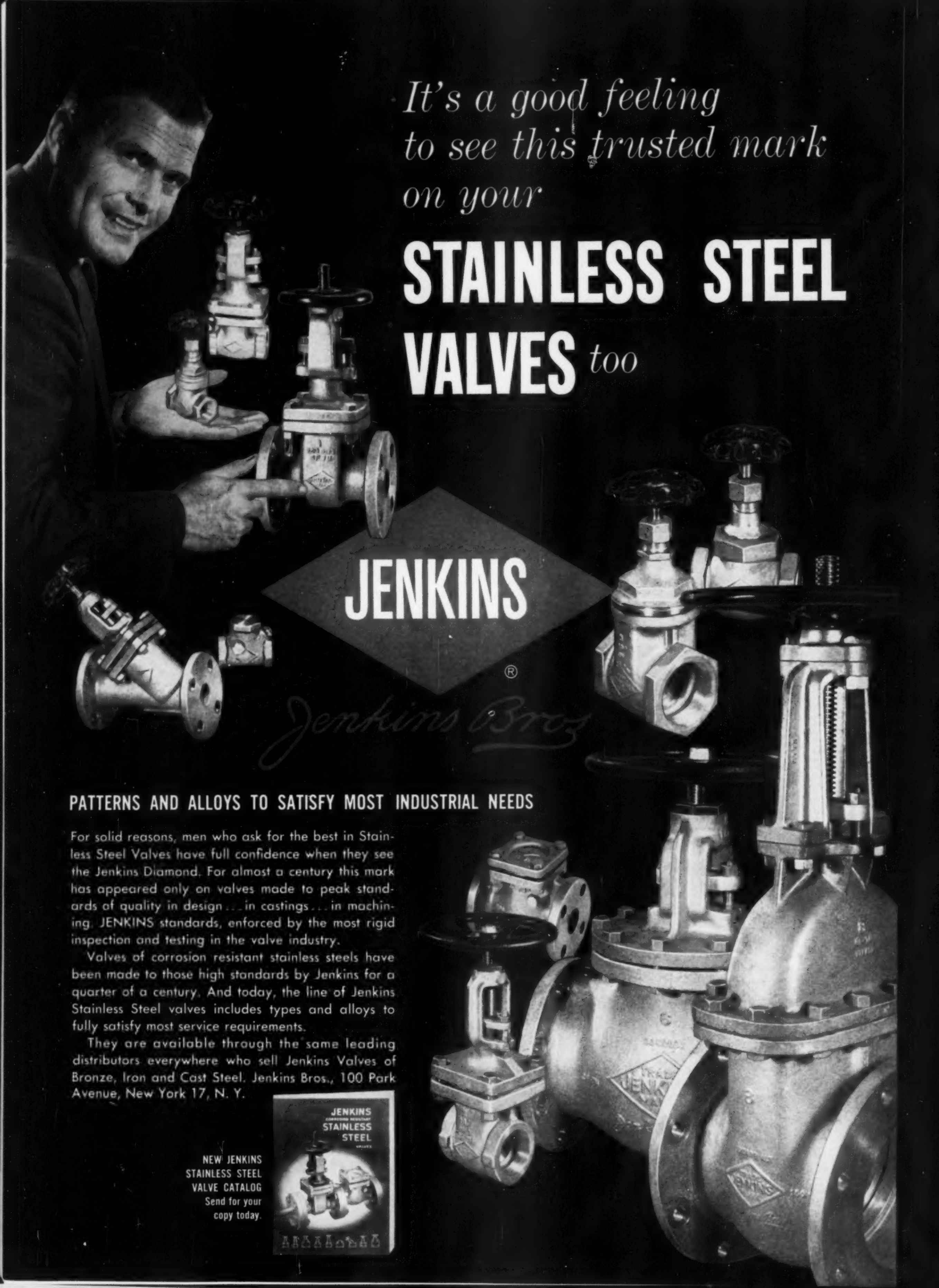
Robert Franklin Throne (1895–1958), retired, chief mechanical engineer, Public Service Co. of Colo., Denver, Colo., died Nov. 8, 1958. Born Marcus Hook, Pa., Jan. 17, 1895. Parents, Norman F. and Alice E. (Waters) Throne. Education, BS(ME), Oregon State College, 1917. Married Rose H. Thomas, 1919. Mem. ASME, 1928; Fellow ASME, 1958. Mr. Throne retired from the Public Service Co. of Colo., after 41 years of service. He had joined the company's predecessor, Denver Gas and Electric Co., as a junior engineer. His service with the firm was interrupted by service in the Armed Forces during World War I. In 1930 he was named superintendent of steam production and in 1953, chief mechancial engineer. Additions and extensions to the company's existing plants totalling 865,000 kw were made under his supervision. He was widely known for his original work concerning cooling characteristics of lakes when used for industrial purposes. He has published papers on the subject in the technical press. Mr. Throne had enthusiastically promoted the activities of the ASME Rocky Mountain Section, having held each of the section offices, and been continuously sought for committee work. In appreciation of his furthering the aims of the Society, in 1955, he was recipient of a 75th Anniversary Medal. He was a registered professional engineer in the State of Colorado. He was an honorary member of Pi Tau Sigma.

Philip Sleight Van Wyck (1889–1958), senior adviser, Government Technical Institute, Insein, Burma, died Oct. 7, 1958. Born, Sehome, Wash., July 14, 1889. Parents, Alexander Wheeler and Annie Frances (Kalloch) Van Wyck. Education, BS(ME), Purdue University, 1911; MS(Ed), Colorado State College, 1939; attended University of Minnesota. Married Clara Pauline Pettersen, 1914. Assoc. Mem. ASME, 1919; Affiliate ASME, 1927; Mem. ASME, 1935. Mr. Van Wyck was the leader of a group of advisers sent to Burma by the Dunwoody Industrial Institute under the sponsorship of the Ford Foundation. Mr. Van Wyck had a distinguished career as a vocational educator and a public servant. Before going to Burma, four years ago, he was acting director of the vocational and technical school, Tacoma, Wash. He had also been president of Farrugut College and Technical Institute, Farrugut, Idaho. He had taught also at the University of Washington, Seattle, Idaho State College, and Colorado A & M College. Mr. Van Wyck had served in many capacities with the U. S. Government. He was director, Bureau of Training, War Manpower Commission; and chief, Division of Occupational Analysis and Industrial Services. He worked also with the Federal Security Agency, U. S. Civil Service Commission, and the National Youth Administration. At Dunwoody Industrial Institute he had been head of the machine, mechanical drafting, and auto departments. He had served in the Armed Forces during World War I. He was the author of a "Foreman Training Manual" and papers published in the technical press. He had served the Society as chairman, Minnesota Section, 1937–1938. He was a member also of ASTE and the American Vocational Assoc. Survived by his widow, Clara P. Van Wyck, Minneapolis, Minn.

Leslie Thomas Warner (1896–1958), construction engineer, Syndey County Council, Sydney, N.S.W., Australia, died Oct. 10, 1958. Born, Sydney, N.S.W., Australia, Feb. 4, 1896. Education, Assoc(EE), Sydney Technical College, 1915. Mem. ASME, 1936. Mr. Warner had been with the electricity department of Sydney since 1916 with the exception of two years spent in the General Electric training course and his service during World War I. He was responsible for the introduction of Busbar Protection of metal-clad switchgear in Sydney. He had been active in encouraging the use of high pressure-high temperature steam generation, often against strong opposition. He was responsible for the design and construction of several large power stations, namely, the "B" Section Bunnerong Power Station and the Pyrmont Power Station of the Sydney System. He also served on a number of committees of the Electricity Supply Association of Australia and on advisory panels dealing with Technical Education of the University of Technology.

Paul Bancroft Wesson (1873–1958), mechanical engineer, Eastman Kodak Co., Rochester, N. Y., died Aug. 14, 1958. Born, Nashua, N. H., Oct. 17, 1873. Parents, Hale and Mary Jane (Bancroft) Wesson. Education, BS(ME), Massachusetts Institute of Technology, 1898. Married Edith May Keith, 1902. Mem. ASME, 1912. Mr. Wesson joined Eastman in 1924. Survived by a daughter, Mary K. Wesson.

DeWitt Howard Wyatt (1888–1958?), whose death recently was reported to the Society, had been senior research engineer, Research Foundation, Ohio State University, Columbus, Ohio. Born, Marion, Ohio, April 15, 1888. Parents, Charles and Sara (DeWitt) Wyatt. Education, attended Ohio State University. Married Leona Davis, 1932. Mem. ASME, 1924. A specialist in the area of refrigeration, heating, and ventilating, Mr. Wyatt held a number of patents and was the author of several papers on subjects related to his area of specialization. He had served the Society as a member of the Nominations, Program, and Membership Committees.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NEW EQUIPMENT

Dust-Tight Valve

A new dust-tight valve for use with general equipment processing or storing dry solids has been announced by Patterson-Kelley Co.

The new general-purpose valve is designed for equipment involved in blending, milling, conveying, or other such operations where the discharge and flow of dry powders and granulations must be controlled.

Available accessories include special adapters for mounting the new valve to existing equipment—including vessels now equipped with slide valves—a plastic bag adapter, and a positive close-off cover for use on vacuum vessels.

All components of the new valve are precision machined for complete interchangeability. The valve body is covered with a removable neoprene liner, and the vane and O-ring sealed shafts are constructed of Type 18-8 chromium-nickel stainless steel. All parts, including the neoprene liner, can be easily replaced in the field.

The discharge handle is operated against a radial, positive-positioning plate which locks the valve securely in position. Easy adjustments can be made for precise positioning and compensated positioning after long wear. Completely dust-tight, the new valve has been tested with a 20-in. head of water.

The new solids flow valve is available in 8, 10, and 12-in. sizes, with $8\frac{1}{4}$, $10\frac{1}{4}$, and $12\frac{1}{4}$-in. openings and $10\frac{1}{2}$, $12\frac{1}{2}$, and $14\frac{3}{4}$-in. OD. All valves are $1\frac{1}{2}$ in. thick. **—K-1**

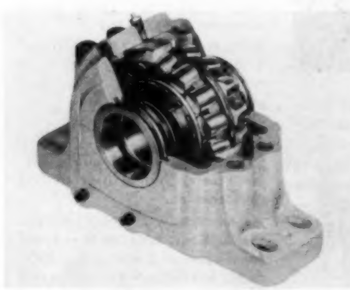
Gas-fired Unit Heaters

A new line of gas-fired unit heaters, in ten sizes from 25,000 to 250,000 Btuh, is now available from Westinghouse Electric Corp., Sturtevant Div.

The new heaters incorporate a contoured aluminized-steel heat exchanger design with combustion occurring within individual tubes for maximum heat transfer.

The units are all equipped with fully automatic, positive safety controls and are available for any type of gas specified: manufactured, natural, mixed, liquid petroleum gas, and liquid petroleum gas-air mixtures. Close-grained, cast-iron air adjustment shutters control the primary air to the gas flame for efficient gas combustion. Adjustable louvers permit variation of discharge air to suit installation requirements.

The fan motors are standard rated at 115 v, 60 cycle, single-phase current and are equipped with automatic reset-type thermal overload protection. The seven smaller units have a permanent lubricated shaded-pole motor. The three larger units have permanent capacitor motors requiring periodic lubrication. **—K-2**

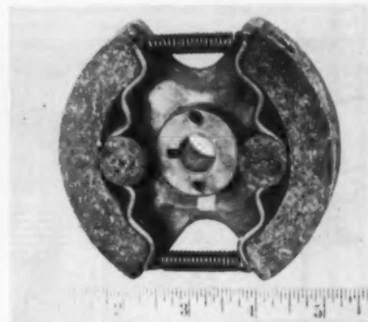


Spherical Roller Bearings

Three major design improvements have been combined to produce what is claimed to be the highest capacity spherical roller bearing yet developed, according to Link-Belt Co.

These features are maximum diameter and quantity of convex rollers for each bearing size; precision machined centrifugally-cast bronze retainers, and high, heavy inner race shoulders.

The new spherical bearings are being introduced initially in Series 22200 and 22300, in bore sizes ranging from 1.5748 to 11.0236 in. with dynamic load ratings up to 288,000 lb. The bearings also will be available in pillow blocks in bore sizes ranging from $1\frac{7}{16}$ to 10 in. **—K-3**



Centrifugal Clutch

A new cam-type centrifugal clutch, developed by Fairbanks, Morse & Co., Magneto Div., uses a moderate camming or locking-in action that permits it to disengage at approximately the same speed with which it engages, with or without load.

Designed to function in applications that have high operating speeds or medium pulsating loads, it affords quick release where necessary, and is said to be ideal for electric motors or gasoline engine applications where gradual engagement is required or in operations starting from high inertia.

In motor applications, the centrifugal clutch provides a low-line voltage protection since necessary starting current is greatly reduced.

When used with gasoline engines, the centrifugal clutch provides no-load starting and no-load idling where constant loading is not desired. The clutch is available in 1 to 30 lb ft capacities, with rpm from 1200 to 3600, $4\frac{1}{4}$ in OD, $\frac{7}{16}$–1 in. diameter bore.

The new clutch line can be adapted to pulley-, sprocket-, gear- or coupling-type drives mounted on driving or driven member. With drive mounted on driven member, clutch may be used as a power take-off. **—K-4**

Pressure Transducers

Bristol Co. is now offering pressure transducers for nuclear applications; primary and secondary loop measurements in pressurized-water reactors, boiling-water reactors, organic-moderated and homogeneous reactors.

Built entirely of inorganic components, the unit is said to be suitable for operation in heavily radioactive environments without being affected. Because the transducer is maintenance-free, it is suitable for sealed operation. The span and zero-trimming adjustments are remote from transmitter. **—K-5**

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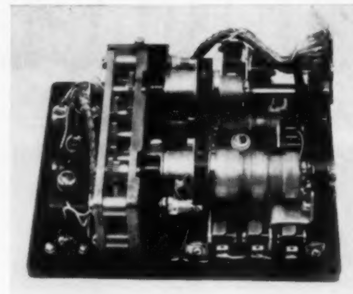

Sequence Timer

A firing circuit sequence timer for air-to-air missiles is announced by Avionic Div., John Oster Mfg. Co.

The unit is designed for repeated engagement through a clutching mechanism requiring a high torque-to-weight ratio, the firm states. It uses a 12,000 rpm motor rated at 0.1 oz-in. to turn three separate timing cams at different rates of speed. The three input shafts for the timing cams turn at 5, 12, and 20 rpm, respectively, being linked to the motor through a speed-reduction gear train.

Three SF-80 clutches, specially designed for this application by Warner Electric Brake & Clutch Co. are used to couple the cams to their input shafts. **—K-6**

Lettering Templates

Addition of five new templates to the Keuffel & Esser Co. Leroy lettering line is announced.

Four of the new lettering aids are members of the miscellaneous template family; the fifth is a new addition to the standard template group, the firm reports. The new styles include, Spartan Medium, in type sizes from .24 to 1.44-in., forming capital letters and numbers that can be drawn solid or in outline form with a 00 or 0 pen.

Shadow, in sizes from .120 to .500-in., forming capital letters and numerals in shadow type. Isometric, in sizes from .100 to .200, forming caps and numbers correctly sloped for isometric drawings. Included in this style category is the 3242A Isometric template which forms isometric representations of circles that can be drawn in all three isometric planes.

Electronic tube symbol, forming practically all the symbols used for various types of electronic tubes and semiconductor devices. It can be used in combination with standard electrical symbol templates and conforms with ASA Bulletin Y 32.2 (1954), military spec. MIL-S&D-15A, and IRE Bulletin 57 IRE 21.53.

Standard lettering templete, new $9^1/_2$-in. long plate that forms .05-in. capitals in vertical or slanting style. **—K-7**

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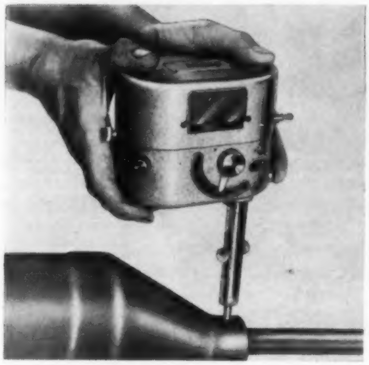

Vibration Instrument

A new, highly accurate mechanically operated instrument which magnifies and permanently records frequency, amplitude, and wave form of vibrations and other mechanical motions has been announced by Korfund Co.

Designated the hand vibrograph, the instrument is said to be the only such apparatus available with both ink and waxed paper recording, and a tape take-up reel for convenient storing of readings. It is also the only such meter with variable tape speed to simplify reading of high frequency recording.

The instrument is designed to simplify machinery maintenance scheduling by providing a permanent record of the vibration amplitude at the time of installation. Comparing the vibration readings on tapes taken at regular intervals, with this original tape, establishes the amount of wear in bearings or cutting tools, indicating when replacement will be necessary, before breakdown, the firm says. —K–8

Pressure Switch/Transducers

Haydon Switch announces its 1500 series pressure switch/transducer, designed for aircraft, missiles and rockets, applications in lubricating, pneumatic, hydraulic, fuel, chemical, and gas pressure systems..

Moving parts are contained in an aluminum housing, environmentally-sealed by O-rings at each end. The assembly weighs 6 oz and is said to be capable of sensing pressure levels of from 0.5 to 4000 psi merely by changing internal modular components. Eight switches will cover the complete pressure span. According to the company, exact calibration of each switch assembly is obtained by rotating the external pressure setting adjustment, which is then securely locked by two set screws.

The unit meets MIL-E-5272A specifications. The assembly is resistant to such corrosive operating media as water-alcohol solutions, nitric acid, and hydrogen peroxide. An optional mounting bracket provides vibration isolation up to 2000 cps and up to 50 g's. —K–9

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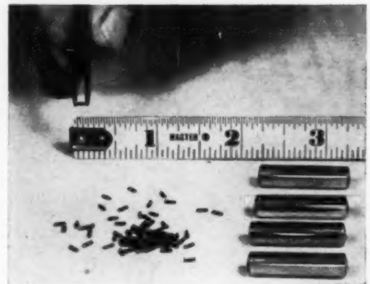

Miniature Locking Pins

A new line of locking drive pins only $^1/_{32}$ in. in diameter and as short as $^1/_8$ in. long, smallest solid pin manufactured, is now being made by the Groov-Pin Corp.

Said to be ideally suited for connecting or locking together two miniature parts, they can be used in such fields as jewelry, optical equipment, manufacturing.

They are made in four types with grooves to meet all requirements, and are of 6150 chrome-vanadium or stainless steel 303. They can be used to replace plain pins or bent wire fasteners. Held within tolerances of ± 0.001, the new pins range up to $^1/_2$ in. in length. —K-10

Oscillographs

Heiland Div., Minneapolis-Honeywell Regulator Co., has developed two new models in its 906 series of direct-recording oscillographs to provide higher recording frequencies and increased channel capacities.

The firm has also introduced two new accessories—a timing unit and a record latensifier—that facilitate operation of its 906 Visicorders.

The new units, designed to monitor and record a variety of electrical and mechanical phenomena during high-speed scientific and industrial testing operations, include:

906A-1, which features high-sensitivity miniature plug-in galvanometers and magnet assembly. This use of subminiature galvanometers permits 14 channels of data to be directly recorded at frequencies from d-c to 5000 cps.

906A-2, with solid-frame galvanometers and magnet bank, that provides for eight-channel recording at frequencies from d-c to 2000 cps.

The new timing unit is a separately-housed multivibrator oscillator that provides short, accurately-spaced pulses to timing galvanometers of .01, 0.1 or 1.0 seconds. The firm says pulse characteristics are such that, with the timing signal applied to two 3300-cycle natural frequency galvanometers, full width time lines will result.

Legible records within a few seconds are possible with the bench-mounted unit that lensifies and spools records. The unit consists of a record takeup unit with drive motor and removable spool. —K-11

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Tramp Iron Separators

A new line of tramp iron separators manufactured by Stearns Magnetic Products features the use of Indox ceramic permanent magnets.

According to the firm, the ceramic material is barium ferrite, pressed into a compact under great pressure and permanently magnetized to produce an ideal flux pattern for maximum effective tramp iron separation.

Indox V magnetic pulley installed at head of belt conveyor system is said to outperform conventional permanent magnet pulleys, equal deep-field power of electromagnetic types. Radial design of magnet assembly is claimed to boost holding efficiency.

The firm's grate magnet is installed in hopper or floor opening, chute or duct to guard product and plant against tramp iron. Collecting tubes have continuous magnetic poles, no "dead" spots, the company states. Effective area is said to be 400 per cent greater than in ordinary grate magnets.

A magnetic drum is designed for process industries where granular materials are conveyed in enclosed chutes and spouts. Revolving stainless steel cylinder inside housing carries material over stationary magnet assembly, which holds tramp iron particles beyond discharge of nonmagnetic product. It is said to produce a uniform field 30 to 40 per cent stronger than ordinary permanent magnet drums. **—K-12**

Large Gearmotors

Two new large-size gearmotors—said to be the largest standard drive units ever produced—are announced by Philadelphia Gear Corp.

Sizes J and H, they are rated up to 200 hp and feature high efficiencies of 94 to 97 per cent, depending upon the number of reductions incorporated. Double, triple and quadruple reductions are available in AGMA ratios ranging up to 440:1. Final stage helical gearing is carburized and hardened and gear teeth are precision ground. The firm says large diameter shafting and oversize bearings have sufficient reserve capacity to handle the most severe overhung loads and shock conditions. Gears, shafting and bearings all meet AGMA standards. **—K-13**

Power Press Brake

A versatile 15-ton power press brake has been introduced by Niagara Machine & Tool Wks.

According to the firm, the unit is capable of a variety of forming, bending, punching, blanking, and related operations. All driving parts are located inboard between housings for greater operating convenience, safety and compactness.

Positive, instant ram control, enabling smooth and sensitive jogging, is claimed to be assured by a heavy duty, synchronized friction clutch and brake. **—K-14**

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Vernier Magnifier

Increased accuracy in reading all vernier scales is said to be possible with a new vernier magnifier manufactured by Bausch & Lomb Optical Co.

The clear plastic body of the magnifier is designed to admit available room light. Two permanent alnico magnets are embedded in the base for attaching to metal scales.

—K-15

Sliding-Seal Valves

A new sliding-seal control valve with threaded exhaust ports has been introduced by A. Schrader's Son, Div. Scovill Mfg. Co.

The valve has $^1/_4$ NPT ports and comes in a complete series of 2, 3 and 4 way types with levers for hand or mechanical actuation.

The new valve is said to be specially suited for operating single or double acting cylinders with a 3-in. diameter bore. This new series of valves has a flow capacity of 55 cfm. —K-16

Self Contained Seal

A new, self-contained, compact seal for 1 in. diameter shafts for use in jet water pumps, oil pumps, reduction units or appliances such as washing machines, has been introduced by Garlock Packing Co.

The firm says the seal can be used on any rotating shaft to seal any liquids that will not attack the Buna-N flexible parts or the brass metal parts. The seal has been designated H (formerly Model BA12A-10), and it is available for $^5/_8$ and $^3/_4$ as well as 1 in. diameter shafts.

The face of the seal, capable of withstanding high face loading and heat, is manufactured from true carbon to prevent porosity.

A roll designed bellows has been incorporated into the new seal which is said to allow greater travel than the old type traditional V-seal bellows. The brass metal shell incorporates a rigid two piece design in which the shell is rolled over an offset washer at the back. —K-17

750 HP Package Boiler

A 750 hp package steam generator, claimed to be the highest capacity fire-tube boiler manufactured since the establishment of the package boiler industry in 1935 is now manufactured by Cyclotherm Div., National-U. S. Radiator Corp. The new unit delivers 26,000 lb steam per hour at over 80 per cent efficiency.

The firm states that because of the patented cyclonic combustion principle incorporated in the design, the new unit is no larger than most 500 hp package generators.

Designed for heavy oil or gas, the boiler can be adapted to burn either LP-gas or light oil, as well. Modulation over an extremely wide range permits guarantee of efficiencies of 80 per cent or better down to a small fraction of the rated 750 hp capacity, the company states. —K-18

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Dialysis System

Development of dialysis equipment for the separation of acids and other chemicals from solution has been announced by Graver Water Conditioning Co. The firm says the new system is known as the Hi-Sep dialyzer (for high-rate separation) and contains the first acid-resistant membranes.

The new membrane is made of a new type of synthetic resin said to be so tough that it will operate for a very long time without requiring replacement, repair or cleaning. Thus, the company says, instead of requiring neutralizing equipment and chemicals for the discharge of acids to waste, these industries can now purchase equipment for recovery of acids that can be reused in processing.—**K–19**

Pilot Check Valves

Fluid Controls, Inc., Mentor, Ohio, has introduced a new line of pilot check valves which feature provisions for emergency manual release.

The valves are normally used with hydraulic cylinders performing lifting or clamping operations, the company reports. The valve locks the cylinder in position to prevent pressure loss due to leakage or line rupture. The new manual pressure release feature is designed to safely release the holding pressure of the clamp on lift cylinder under such emergency conditions as power failure.

The valves are of the spring loaded ball type and the manual release provision consists of a screw which depresses the ball check, permitting hydraulic oil to release the valve. They are available in both single and double models and are designed for oil pressures up to 3000 psi. Port connections are available to accommodate 1/4, 3/8 and 1/2-in. pipe sizes. —**K–20**

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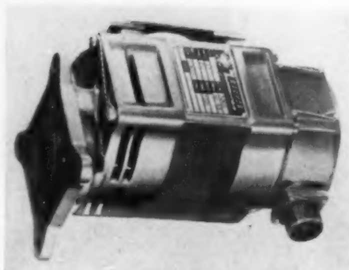

New 28-Volt Motor

Hoover Electric Co. announces production and availability of a new d-c 28-v motor for applications on aircraft, missile, ordnance, marine, and industrial equipment.

The motor delivers 2.0 hp at 3000 rpm. The mounting flange is a modified AND-20001 configuration. The motor has the open frame construction and features an integral cooling fan. Standardized flame quench rings, to provide complete explosion proof feature under adverse operating conditions, are available. Also available is a radio noise filter to meet military specification MIL-I-6181B.

The foot mounting can be changed to accommodate end mounting or pad mounting. Other output shafts are available for keyed, splined, or flats. **—K-21**

Swivel Joint

A ball-bearing swivel joint featuring interchangeability of packing to provide for multiple services is announced by Chiksan Co.

Services range from handling chemicals at temperatures between −40 and +400 F at 300 psi internal pressure to handling steam and hot gas, providing for steam service rotation with a recommended maximum of 440 F at 360 psi. Maximum temperature rating is 600 deg at 200 psi for occasional swing or oscillating services. Cold working pressure is 1000 psi.

Molded elastomer packings, including the new Viton "A", are available for use with many chemicals and for general liquid services. For steam, hot gas and certain chemicals, a disc seal is used.

The design of the joint is such that packing seals may be replaced without removal of the joint from the line, the firm states.

When used with disc seals, the sealing chamber contains a set of inconel springs which exert uniform pressure on a pressure ring. When used in services where the molded packing is recommended, these elements are easily removed and the molded packing inserted. The only tool required to execute this switch is an allen-type wrench. **—K-22**

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Retaining Rings

A new high-strength, precipitation hardening stainless steel alloy which provides unusual corrosion resistance at temperatures up to 1000 F is now being offered by Waldes Kohinoor, Inc.

The new alloy—Armco Type PH 15-7 Mo—has never before been used for retaining rings, according to the company. The new stainless steel is expected to be used widely for rings installed in food machinery, beverage dispensing and photographic processing equipment, aircraft and missile parts, nuclear reactor components, household appliances and marine equipment and other outdoor applications where retaining rings are subjected to strongly corrosive conditions.

PH 15-7 Mo is similar in corrosion resistance to the 300 series stainless steels. Unlike the 300 series, however, it may be hardened to provide the spring characteristics necessary for retaining ring application. High strength-weight ratios make possible unusual strength and heat resistance with minimal weight, the firm reports. **—K-24**

New Shaker Designs

Two wide-band electrodynamic shakers of improved new design have been placed on the market by Ling Electronics, Inc.

The shakers are Model 219, rated at 500 lb force output, and the Model 227, rated at 150 lb force output. According to the company, an outstanding design feature of the shakers is elimination of all secondary structural resonances, so that the armature behaves as a simple single degree of freedom system over an extended frequency range.

Another feature is a dual magnetic field structure which yields maximum force at low power input with low stray magnetic field and improved force/current linearity.

The Model 219 has a 7.5 lb armature of extruded, webbed aluminum construction. The armature allows a high first bare table resonance of 6000 cps, or 4000 cps with a 13-lb load.

The shaker design provides simplicity and ease of compensation over wide-band widths to 6000 cps and with no compensation required below 3000 cps.

Armature suspension is the symmetrica loop flexure type patented by Calidyne. The loop flexure provides resonant-free single-axis motion with high transverse stiffness, according to the firm.

The smaller Model 227 has a 1.75-lb armature. The inherent rigidity of the armature maintains a high first bare table resonance of more than 9000 cps, or 7000 cps with a 1.81-lb load, and 6000 cps with a load of 3.44 lb. This model also provides simplicity and ease of compensation over wide-band widths extending to 10,000 cps, and requires no compensation below 5000 cps. **—K-25**

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Bucket Elevator Pulleys

New welded-steel bucket elevator pulleys developed by American Pulley Co., have accurately roll crowned pulley rims for easy belt tracking.

Two types are available: face widths up to and including 13 in. width are made with one center disc; and pulleys with wider faces are made with two discs and two hubs.

Center discs are corrugated so that belt pull stresses resulting at the hub section are dissipated. The firm says hubs, saw-slit through one side, have accurately machined tapered shoulders which match the inside tapered bore of the discs. Six or eight high-tensile bolts pull each hub into its mating disc and clamp the pulley to its shaft with a permanent grip. **—K-26**

Lubricated Pillow Blocks

A new line of permanently lubricated pillow blocks has been introduced by Marlin-Rockwell Corp. The firm says the ball bearings used in the blocks are pre-lubricated at assembly with the proper amount of high quality grease and the need for any further lubricating is eliminated.

Lubrication is retained in the bearing by a highly efficient, patented Labri-Seal, said to combine the advantages of a rotating flinger, labyrinth seal and positive contact synthetic rubber seal.

The new pillow block permits the bearing to adjust to shaft misalignment and still maintain full contact seating of the bearing in the housing, the firm states. It fits standard inch shaft dimensions and is interchangeable with most other types of pillow block installations. **—K-27**

Shelter-Clad Switchgear

Shelter-clad switchgear, designed to facilitate preventive maintenance of outdoor units during inclement weather, has been introduced by Allis-Chalmers.

The switchgear has a sturdy, weather-protected housing with a 75-in. wide aisle said to afford protection in all kinds of weather for inspection or on-the-spot maintenance.

According to the company, the completely weather-proof work area on a sturdy steel plate floor with built-in, nonsag feature makes it possible to check the breakers without exposure to weather and the need for a transfer truck. The area, with light switch and utility outlet adjacent to doors at either end of the unit as well as a light fixture over each breaker, provides control room atmosphere.

The trunnion mounted potential transformers can be placed over the breaker unit in the superstructure for ease of inspection and aisleway accessibility or they can be placed in an auxiliary cubicle when such is provided. Maximum accessibility of component equipment is possible from the aisleway. **—K-27A**

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Solenoid Valve

A 3-way nylon body solenoid valve claimed to outlast and outperform steel has been introduced by Valcor Engineering Corp. With bubble-tight sealing, the valve is available in normally open, normally closed and directional control configurations. It is shock-resistant and pressure-proof, and is available in all normal a-c and d-c voltages. —K-28

Silicon Rectifier Units

Syntron Co. announces that its a-c to d-c rectifier power units, regularly available with selenium rectifiers only, have been improved to include the choice of silicon rectifiers as well.

The improvement affects the company's complete line of three-phase and single-phase, high and low voltage Power Units. —K-29

Glass Insulation

Pittsburgh Corning Corp. has announced development of a new line of low-cost rigid cellular glass insulation for hot and cold commercial piping applications.

The company now is offering for the first time a special Foamglas insulation for commercial piping in a temperature range of 35 to 350 F. New production equipment allows the company to price the material so that it is now possible to install permanently vapor-proof, incombustible, waterproof, dimensionally stable Foamglas pipe covering for approximately the same cost per linear foot as other commercial pipe insulations, the firm states.

The new material is shipped in 24-in. lengths, factory-wrapped with a dual purpose kraft and aluminum foil laminate by specially designed equipment. —K-30

Photo-Electric Reader

Computer Div. Bendix Aviation Corp. has added a new photoelectric paper tape reader to its G-15 computer accessory line. Capable of accepting any five, six or seven channel numeric tape for computer input, this unit is designed for reading tapes from all types of off-line recording devices.

Designated as the Model PR-2 reader, the new accessory is compatible with tape punching cash registers, accounting machines, adding machines, typewriters and many other types of recording equipment. The firm states principal applications include process industry data handling, retail and wholesale sales analysis; payroll, cost and inventory control, and similar problems.

The new reader operates at four hundred characters per second and will stop or start on one character. In addition to positive and negative numbers, the external code may include control characters and certain special characters. Any five, six or seven channel numeric code can be read and translated to G-15 code. Simple adjustments allow for acceptance of different external codes. —K-31

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Airspeed Computer

A new light-weight true airspeed computer that is completely transistorized and requires only 10 w of power is being produced by Minneapolis-Honeywell Regulator Co.

The firm says the computer is for use in aircraft and missiles when critical airspeed computation is not available through a central air data computer. Designated HG 45, the computer has a range up to 750 knots and 55,000 ft altitude at −65 to 170 F. It was designed, depending on the flight envelope to hold an accuracy of 1 per cent or less.

Weight of the computer with shock mounts is 4.2 lb, and size is less than .2 cu ft. It meets MIL-E-5400B requirements of 10 Gs vibration and 15 Gs shock.

Principal components include the firm's PG 27 altitude and PG 32 differential pressure transducers, a modified fuel gage amplifier and servo loop, and a temperature probe. **—K-32**

Oil Reclaimer

Hilliard Corp. announces its oil reclaimer Model 25-X, a relatively compact system designed for purification of sealed transformer insulating oil prior to its delivery to the transformer charging boards.

The new unit consists of an inlet filter utilizing fullers earth filter cartridges, submerged inlet and outlet rotary gear pumps each driven by its own motor for automatic operation, an electrically heated vacuum vaporizer with a built-in 60 gal vacuum storage tank, and a vacuum pump capable of producing 50 μ vacuum during oil processing.

Featured on the new reclaimer are the utilization of a single cylinder for the vacuum vaporization chamber and vacuum storage tank, automatically operated inlet and outlet delivery pumps to prevent pumping air to the transformer charging board, and delivery of oil to the charging board with a moisture content of less than two parts per million. **—K-33**

Indicating Controllers

Minimum air usage, cartridge components, and improved readability are features of a new series of compact thin-line temperature and pressure controllers announced by Powers Regulator Co. for heating, ventilating, and air conditioning.

Called the Series 200, the indicating pneumatic control instruments are available in three temperature and four pressure ranges for stock delivery.

The controllers are used with diaphragm-operated valves for gradual accurate regulation of temperature or pressure. Changes are sensed by a remote nitrogen-filled bulb connected by a capillary to the controller. For pressure control, a pressure spiral element is used. These changes are relayed by the controller to the valve, which modulates the heating, cooling, or pressure medium to keep the process at the desired point. **—K-34**

Manual Valve

A reverse acting, knob controlled, panel mounted manual valve for up to 200 psi pneumatic and hydraulic or vacuum service suited for emergency control applications where a fast push-type action is more desirable than the standard pull-type, is announced by Valvair Corp.

Reverse action is imparted by a standard spring return end section, mounted on any of the firm's standard 2, 3, or 4-way manual valve body, in sizes from $^1/_4$ through $^3/_4$ NPT. Three and four-way types are available with open-end or piped exhaust.

The valves are claimed to offer simplified and positive panel mounting, using a spacer and flanged end bearing supplied with the valve. Standard maximum panel thicknesses range from $^5/_8$ in. for $^1/_4$ in. NPT valves to $1^1/_8$ in. for $^3/_4$ in. NPT types. A choice of spacers permits mounting of valves in panels less than maximum thickness and allows use of various sized valves in the same panel, says the manufacturer. **—K-35**

High Power Relay

A new heavy duty power relay has been added to the recently introduced line of relays offered by the Acro Div., Robertshaw-Fulton Controls Co.

Outstanding feature of the new relay, according to the company, is its ability to carry an extremely heavy load. The switch has been approved by Underwriters' Laboratories for a rating of 20 amp, 2 hp, 230 volts a-c. Largest dimension of the relay is less than 3 in., length is $2^1/_{16}$ in., and width about $1^1/_2$ in.

The control is designed on a modular basis so that either switch or coil can be replaced without removing the relay from its mounting. The relay is available for either side or bottom mounting.

A variety of multiple circuit arrangements is available including: double pole double throw; single pole double throw; double pole single throw—NC; and double pole single throw—NO. Available coil voltages for a-c include 24, 32, 115 and 230. For d-c applications voltages available are 12, 30 and 115. **—K-36**

Refractory Brick

Refractories Div., H. K. Porter Co., has announced a new refractory, Multex-85, a chemically bonded, high alumina refractory brick, specially developed for the aluminum industry.

Three major features are: molten aluminum will not penetrate it; silicon pick-up is reduced; the tendency of drosses and fluxes to adhere to sidewalls is reduced.

The material has both high strength and good spalling resistance and is recommended where operators of aluminum furnaces prefer preformed brick. Applications are in aluminum furnace hearth bottoms and sidewalls: reverberatory remelt, holding, alloying, and reclaiming, the firm states. **—K-37**

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Submersible Motor

What is described as the first oil-filled submersible motor ever offered as a complete unit for four-inch well applications has been introduced by General Electric's General Purpose Motor Dept.

Because of its design, the new submersible motor can carry significantly greater loads per rated horsepower than other type constructions, according to the company.

Fast heat dissipation is one of the primary advantages of the oil-filled design, the firm states. The motor's large supply of highly refined mineral oil continuously circulates around the windings with rotor movement quickly transferring internally generated heat to the cool motor shell. This efficient heat transfer is the principle reason for the motor's high load carrying ability, according to the firm. A $^1/_2$-hp unit, for example, offers a 1.60 service factor.

The oil-filled design provides inherent protection against stall and other overload conditions. The windings have unrestricted freedom to expand which helps prevent damage during heat generating conditions.

A specially designed lead seal eliminates capillary action of the lubricating oil. The lead connection—solid in the middle and molded in neoprene—avoids oil loss and lead deterioration. A sand slinger throws foreign particles away from both shaft and seal by centrifugal force.

Stator windings on the new submersible pump motors are protected against electrical stresses and moisture with Mylar polyester film, selected Formex magnet wire and a special triple-dip and bake varnish treatment.

A large spring-loaded flexible container, which holds the highly refined mineral oil, expands and contracts easily with temperature changes. The steel spring inside the oil reservoir is designed to maintain positive internal pressure at all times to keep water out. **—K-38**

Pipe Hanger Ring

A universal adjustable pipe hanger ring developed by Auto-Grip Div., Automatic Sprinkler Corp. of America is said to provide a single unit which can be used in most applications in place of most other types of pipe hanger rings.

The ring consists of a metal band and a locking insert for attachment to a threaded hanger rod. The firms says that because of low initial cost and reduced installation time, installed cost is lower than that of other types of hanger rings. The insert is self-locking through spring action as well as through the weight of the pipe supported.

The ring is available in zinc or copper plate as standard, for pipe sizes from $^1/_2$ through $3^1/_2$ in. The band may be readily reshaped on the job if conditions require it, the company reports. **—K-39**

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Push Button Station

A new push button station with neoprene housing which features waterproof, noncorrosive, light-weight construction has been announced by Electrical Products Div., Joy Mfg. Co.

The station is available in either three or four-button models. The firm states that the two-piece neoprene housing weighs only a fraction of any conventional cast iron unit, is about $^1/_3$ the size, and offers completely waterproof, rustproof, and corrosion-proof construction. Special grommets are supplied with each unit to fit several cable sizes and assure 100 per cent weather-tightness.

Each button is an integral part of the housing and completely encloses, by continuous design, the precision snap acting switches and protects them from water and weather, the firm says. **—K-40**

BUSINESS NOTES

Chain Agents Named

Acme Chain Corp. announces the appointment of Koenig Hardware Co., Linden, N. J. as distributor for its entire line of roller chains, sprockets, and conveyor attachments.

Central Engineering & Supply Co., Passaic, N. J. has also taken on the complete line, the firm reports.

Agricultural Chain Division

Chain Belt Co., reports completion of a new addition at its Agricultural Chain Div., Dolton, Ill.

The new addition takes in 19,200 sq ft of floor space and increases the total floor area at the Dolton Plant to 75,880 sq ft. It will permit increased production of agricultural roller chain and will house expanded shipping department facilities.

Acquires Bearing Company

Control of Reed Instrument Bearing Co. Los Angeles, Calif., has been acquired by SKF Industries, Inc., according to an announcement by the firm.

Operating as the Reed Instrument Bearing Co., Division of SKF Industries, Inc., the addition will provide precision instrument bearing users with complete SKF research, engineering, manufacturing, and marketing service and know-how, plus continuing the Reed policy of close design and application liaison in one of the nation's key instrument manufacturing areas, the company states.

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Warehouse Stocks Sprockets

Acme Chain Corp. announces its Dallas warehouse has added a line of finish bore sprockets, which includes 433 different bores, ready for use without reboring.

Forms Industrial Unit

Formation of an Industrial Division by American-Standard has been announced by the company. The new division was created by the consolidation of the American Blower, Kewanee Boiler, and Ross Heat Exchanger Divisions.

The new division will continue to manufacture and market the same products made by the three separate divisions. Among these are air handling and air conditioning equipment, commercial and industrial boilers, fluid drives, heat exchangers, and surface condensers. Division factories are located in San Leandro, Calif., Columbus, Ohio., Dearborn, Mich.; Kewanee, Ill.; and Buffalo, N. Y.

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Roller Chains, Sprockets

A 98-page catalog featuring the firm's line of roller chains, sprockets, conveyor chain attachments, engineering formulas and installations, is announced by Acme Chain Corp. **—K-41**

Magnetic Separator

A high-intensity magnetic separator of the induced roll type is described in a bulletin released by Stearns Magnetic Products.

The four-page booklet is supplemented by specification sheets, and shows installations. It explains the principle of operation and suggests applications. A table lists more than 100 minerals, gives the source of the sample and the calculated attractibility. **—K-42**

Square Design Cylinders

Miller Fluid Power Div. Flick-Reedy Corp., has issued a catalog sheet which contains drawings comparing the mounting space required for various bore square type 4-tie-rod design cylinders with similar bore sizes of the common threaded or keeper ring type cylinders.

Interchangeability, space-saving features, mounting strength, cylinder strength, appearance, and drafting advantages of the square, 4-tie-rod design are discussed along with its contribution to the high degree of dimensional standardization already achieved in the cylinder industry. **—K-43**

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Hydraulic Cylinders

Bulletin JH-104N, covering the hydraulic cylinders, is announced by the Miller Fluid Power Div., Flick-Reedy Corp.

It contains descriptive information on new job-rated model J hydraulic cylinders for 500-2500 psi service and Power-Packed model H hydraulic cylinders for 3000-5000 psi service. Charts and descriptive data on column strength, piston rod deflections, acceleration, factors of safety, cylinder forces, pressure losses in pipes, factors to consider in selecting cylinders are included in the booklet. **—K–44**

Aftercoolers

An eight-page bulletin, 302.6KI, released by American-Standard, Ross Heat Exchanger Div., presents its A-100 line of pipeline after-coolers.

Among principal features described and illustrated are steel shell construction, removable corrosion-resistant tube bundle, counter current flow design, and a new, advanced centrifugal moisture separator. The standardized parts are said to eliminate high engineering costs and delays involved in custom fabrication. **—K–45**

Saw Blade Selection

Ladish Co. has announced a 31-page saw blade handbook and catalog which presents guides for getting maximum cutting performance and blade life.

The booklet, Bulletin 578, shows how to select proper blade, correct feed, speed, and tension, and tabulates sizes and types o blades available in complete Ladish blade line. Common cutting problems and their solution are tabulated along with recommendations for cutting a variety of metals and nonmetals. **—K–46**

Blow-off Valves

Bulletin B-435, Supplement A, put out by Yarnall-Waring Co., describes the firm's new unit tandem blow-off valves for boiler blow-off pressures to 665 psi, basic pressure rating 400 psi.

The bulletin contains description, operating details, materials, dimensions, advantages of the units. **—K–47**

General Purpose Controls

GEC-1260C, an 88-page publication, covers the complete line of control devices manufactured by General Electric's General Purpose Control Dept.

Selection charts covering starters through 200 hp provide selection of the proper starter, heater, and pushbutton station. The catalog has guide form specifications for designation of controls, and includes product descriptions of motor starters, contactors, relays, solenoids, limit switches, pushbuttons, and pilot devices. **—K–48**

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Welding Assemblies

Designers, engineers, and other industrial personnel charged with specifying and buying welded assemblies will find a valuable guide in the 60-page catalog published by American Welding & Mfg. Co. which covers welded assemblies for commercial and military customers.

The catalog features pictures of typical assemblies and such information as material, size, weight, manufacturing processes, and testing requirements. Typical assemblies include aircraft and missile components, railway parts, steam turbine and diesel engine components, transformer cases, JATO cases, nuclear energy parts. —K–49

Space Heaters

An eight-page bulletin gives engineering data on the redesigned line of heavy duty space heaters now in production by the Reznor Mfg. Co.

The bulletin gives construction details and specification data on ten models for gas, oil or gas-oil firing ranging in capacity from 400,000 to 2,000,000 Btu/hr output. Data includes dimensions for up-flow, down-flow and horizontal installation, lists of control elements with a step-by-step description of the operating sequence, air throw figures for various louver arrangements and details. —K–50

Aluminum Forging

The world's largest and most versatile aluminum forging facilities are described in a new Aluminum Co. of America publication.

The 36-page booklet discusses the equipment, products, and services of plants which regularly produce aluminum and magnesium forgings. The array of facilities needed to produce various kinds of forgings are described. They range from a 50,000-ton hydraulic press to forging hammers, upsetters, a ring roller, and one of the world's largest die shops. —K–51

Mechanical Shaft Seals

A new catalog section on mechanical seals which positively stop the leakage of gas and liquids from around the rotating shafts of pumps, compressors, mixers, and which eliminate adjusting, repacking and other maintenance, is announced by Syntron Co.

First three pages contain typical installations, descriptions, data and specifications for mechanical shaft seals in a range of sizes for shafts with diameters of from $^1/_4$ to $3^{15}/_{16}$ in. —K–52

Gas Pumps

A revised bulletin covering Type XA rotary positive gas pumps has been issued by Roots-Connersville Blower Div., Dresser Industries, Inc.

Technical rating data is presented along with detailed design and construction data. The pumps utilize the firm's rotary positive displacement principle to assure a constant volume of gas with each revolution. —K–53

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Custom Gears

Illinois Gear & Machine Co. has issued a brochure on the company's products, plant facilities, quality control facilities. Information is also given on capacities, types, processes, materials, heat treatments and equipment of the company, which is one of the world's largest manufacturers of custom gears. **—K-54**

Centrifugal Pumps

Bulletin 720.4, describing its line of single stage side suction centrifugal pumps with open impeller for a variety of industrial uses, is available from Goulds Pumps, Inc.

The pumps are available in 13 sizes, $1^1/_4$–8 in., capacities to 3000 gpm and heads to 180 ft, with the addition of two large sizes: $6 \times 8 - 13$ and $8 \times 10 - 11$. Specifications, sectional view, dimensional chart, materials of construction and parts interchangeability charts, and performance curves are included in the eight-page bulletin. **—K-55**

High Pressure Seals

An engineering bulletin, HEX-10, illustrates and describes single-unit high pressure seals manufactured by Automatic & Precision Mfg. Co. for commercial and military subminiature toggle and push-button switches.

Called Hexseals, these switch-boots replace the hexagonal mounting nut ordinarily used to mount a switch, and serve as both seal and locknut, the firm reports. An introductory paragraph describes the sealing and mounting principle used in the design, and three line drawings illustrate the novel design features. Dimensions and part numbers are given in tabular form. **K-56**

Electric Strip Heaters

Edwin L. Wiegand Co. offers a new bulletin, F-1613, that illustrates its line of Chromalox electric strip heaters.

Thirty-two illustrations show how this type of heater is used to keep viscous and heavy compounds moving smoothly; for ovens and special-purpose air heating; for tanks, kettles, drums; and for new or converted platens and other production equipment. Presentation of typical examples for each of the general purposes includes applications of both straight and curved elements to a wide range of equipment sizes and shapes. **—K-57**

Full Flow Filters

Full flow filters with many new features are described in a bulletin issued by Hilliard Corp., Purifier Div.

The new oil filters are designed for full-flow filtration of diesel, gas engine, turbine, lubricating, and hydraulic oils and for filtration of various types of industrial oils, fuel oil, solvents, coolants, used in the manufacturing and chemical process industries. In addition to descriptive information, the bulletin contains data table on the selection of the proper filter. **—K-58**

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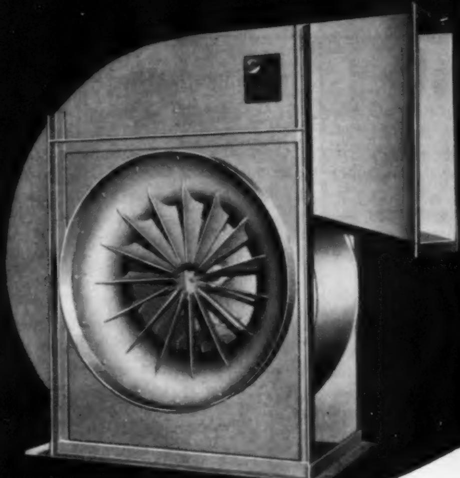
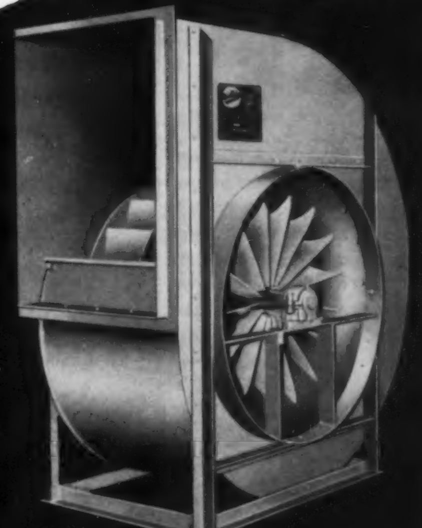


"Buffalo" Type "BLH" Fan
For Classes III & IV Service

"Buffalo" Type "BL" Fan
For Classes I & II Service



The high performance characteristics of these two outstanding "Buffalo" Fans has resulted in their widespread use in the field of industrial air handling. In addition to offering peak-efficiency operation in their respective classes, both the "BL" and the "BLH" bring you a bonus economy factor of *maintenance reduced to an absolute minimum* throughout a long, productive life. This minimum maintenance factor is directly due to unusually rugged "Buffalo" construction features such as:

HOUSINGS — The heavy gauge sides and scroll are of all-welded construction. Heavy structural steel bracing provides housing stiffness and rigid bearing support. Flanged inlets and outlets give added support.

SHAFTS — Hot-rolled or forged shafts are ground to close tolerances for perfect wheel and bearing fit.

WHEELS — Sturdy backward-curved blades are welded to the die-formed shroud and welded or riveted to the solid backplate. Heavy hubs assure permanent shaft alignment. For higher tip speeds, reinforcing rings provide necessary wheel rigidity.

BEARINGS — Self-aligning anti-friction bearings are designed for continuous operation at maximum tip speed. Horizontally split, ring-oiled, self-aligning, babbitted sleeve bearings are also available.

For full details, contact your "Buffalo" representative, or write for Bulletins F-102 and F-200.

Minimum maintenance is assured by the famous "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life in every "Buffalo" product.

"Buffalo"

BUFFALO FORGE COMPANY

148 Mortimer Street • Buffalo, N. Y.

BUFFALO PUMPS DIVISION, BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Dry Feeder Machines

Syntron Co. announces publication of a catalog on dry feeder machines for providing accurate feeding of dry chemical reagents for water filtration, sewage disposal, and other industrial processes.

Eight illustrated pages give descriptions, data and specifications of five standard feeders with vibrated hoppers. **—K–59**

Unit Air Compressors

A 12-page bulletin describing unit type air compressors has been issued by the Le Roi Div., Westinghouse Air Brake Co. The bulletin, numbered SG-2, describes G single-stage, YS single-stage, and YC two-stage compressors ranging in size from ½ to 15 hp. Available pressures are from 80 to 250 psi. **—K–60**

Flexible Metal Hose

Korfund Co., Inc. has published a bulletin which gives detailed instructions on how to install all types of flexible metal hose properly, in order to secure the longest service and best results.

Bulletin N14A is illustrated with eight diagrams to explain correct use of flexible connections to compensate for misalignment, and to eliminate vibration transmission. It discusses the problems of offset and vibration, and gives eight essential points to observe when installing metal hose. **—K–61**

Control Panel Accessories

Panellit, Inc. has released Bulletin 104, which illustrates and describes five accessories for use with control panel information systems.

The accessories are liquid level indicators which show fluid level at remote points, interlock receptacles for safe operation in hazardous places, mercury pushbutton and selector switches for Class I Division 2 locations, plug-in tester for operational testing of relays, and mechanical pushbutton switches for panel mounting. **—K–62**

Aluminum Materials

Design information on architectural applications of aluminum is available in a brochure offered by the Metals Div., Olin Mathieson Chemical Corp.

The 12-page booklet contains a detailed listing of the properties of architectural aluminum alloys and their use in both standard and basic mill products as building components and materials. A special section describes the varieties of special finishes available with aluminum, their appearance and how they are obtained. **—K–63**

Weighted Gage Cock

A new circular, describing bronze "Renewo" weighted gage cocks as an effective aid to safe boiler operation, is available from the Lunkenheimer Co.

The circular, designated No. 183, gives instructions on installing, adjusting, renewing, reversing, and replacing the cocks. Features of these cocks—renewable seats and discs, non-interference of levers, no stuffing box, reversible levers, easy scale formation removal—also are illustrated. **—K–64**

Horizontal-Grate Cooler

A four-page bulletin, describing and illustrating new horizontal-grate cooler designed to cool materials discharged from rotary kilns, sintering machines, roasters, and various types of furnaces, is being offered by the Fuller Co.

Numbered CO-6, the bulletin discusses the advantages of the new unit including: shorter installation time, reduced height, shorter length where necessary, improved control of secondary air temperature, and the need for less refractories. Maximum heat recovery, visibility of the material bed, and adaptability to installations where bulkier units could not be used is also explained. **—K–65**

KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Center Bonded Mountings

A four-page product bulletin describing the vibration isolation and heavy shock absorption features of center bonded mountings is now available from Lord Mfg. Co.

Bulletin No. 712 includes data on design features, installation, performance and specifications of both compression-type and shear-type mountings. **—K–66**

Spray Nozzles

Bulletin 6A-627 prepared by Schutte and Koerting Co., describes the company's line of spray nozzles for spraying large quantities of liquids at low pressures.

The nozzles produce medium to coarse, uniformly distributed, solid-cone sprays with a normal spray angle of 70 deg. Nozzles are available in several sizes to provide a wide range of capacities depending upon the size of orifice opening and liquid supply pressure. At 10 psig, for example, nozzles provide capacities from 1.2 gpm up to 120 gpm. With 100 psig supply pressure these nozzles deliver from 3.75 to 375 gpm. **—K–67**

Roof Ventilators

An eight-page brochure, No. 4004, describing construction features, capacities, quietness levels and accessories of a new line of centrifugal type roof ventilators is available from American-Standard, American Blower Div.

Design and construction features of 13 basic ventilator sizes including 111 different motor and belt-drive combinations are listed for various building environments. A capacity table for the motor-drive combinations includes catalog numbers, quietness rating, motor hp, fan rpm, tip speed, cfm at various static pressures and net weight. **—K–68**

Welding Wire Comparison

Four-page folder, Bulletin DH-1218-O, has been prepared and released by the Page Steel and Wire Div., American Chain & Cable Co. It replaces all previously issued ACCO bulletins on welding wire comparisons.

The new folder details the physical properties as welded, gives analyses, tensile strength, elongation and average Rockwell hardness numbers. In addition, it lists typical uses of gas welding rods, bare electrodes, automatic welding wire and metal spray wire. **—K–69**

Gas Turbines

Clark Bros. Co., announces Bulletin 167, detailing operating experience with the Mark TA 750/1000 kw gas turbine.

Design features, types of fuels (natural gas, distillate, crude oil) plus applications in oil fields and process industries are discussed. Also included is an assessment of the integrated turbine-boiler package and likely future trends in turbine application. **—K–70**

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Flexible Shaft Machines

Grinding, sanding, polishing, buffing and drilling attachments for multispeed or single-speed flexible shaft machines are illustrated in Catalog 59 available from Stow Mfg. Co.

The machines are available with truck, pedestal, bench, and suspension type mountings. —K-71

Force Measurement

A semi-technical booklet describing and comparing modern industrial techniques for measuring force, weight, and pressure, is now offered by the Electronics & Instrumentation Div., Baldwin-Lima-Hamilton.

Illustrated with sketches, charts, and diagrams, the booklet reviews the current state of the art, describes in detail the advantage of electronic force measurement, and outlines the principles of SR-4 bonded strain gages and their use in force measurement devices. —K-72

Flexible Gear Coupling

A four-page folder has been produced by Sier-Bath Gear & Pump Co., Coupling Div. detailing its new Nyflex flexible gear coupling with a nylon sleeve.

The folder provides descriptive data about the new, lightweight coupling and includes tabular data covering horsepower, speed ranges, and bore sizes available. —K-73

Decimal Chart

A decimal equivalent chart, with fractional units from $^1/_{64}$ to 1 in., is available upon request from Ohio Seamless Tube Div. Copperweld Steel Co.

The chart measures $8^1/_2 \times 11$ in. Printed on heavy, coated white card stock with rounded corners, it is punched for convenient wall hanging. It is also suitable for use in standard three-ring binders and under glass desk tops. —K-74

Boiler Guide

A 20-page boiler selection guide has been released by Cleaver-Brooks.

It covers such topics as first cost vs. operating costs, selecting the right fuel, how to save on construction costs, how to solve the low-head room problem, the packaged boiler vs. the built-up boiler, boiler design standards, burner efficiency. —K-75

Gear Checker

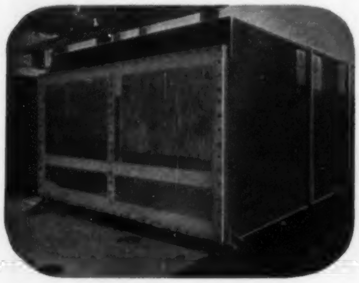
A new gear checker, Model 1218A—with an integrated optical system for easy and accurate checking of gear leads—is described in a new bulletin available from Michigan Tool Co.

Designated 1218-A, the bulletin details design, construction, and operation of the checking instrument that eliminates gage blocks, multiple settings, micrometers, verniers and gear trains from the setup procedure. —K-76

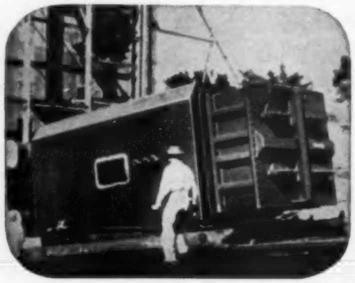
and auxiliary equipment

HOW C.H. WHEELER CONDENSER DESIGN

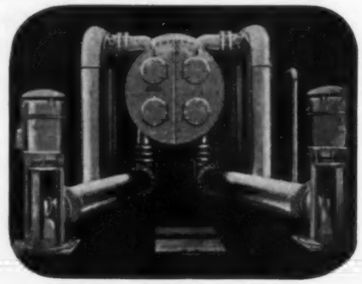
saves space...



Head Room problems are solved by compact condensers like this one. Turbine floor to basement floor, in this case, is only 20 ft. The Unit has 65,000 square feet of condensing surface.

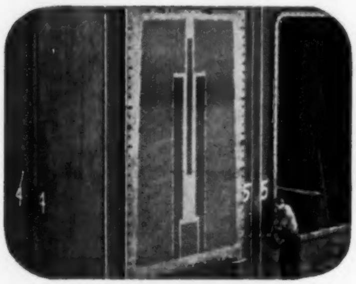


Rectangular Cross Section makes C.H. Wheeler Condensers adaptable to nearly any space or condenser arrangement because the length, width and height of any Wheeler Unit can be varied almost at will.

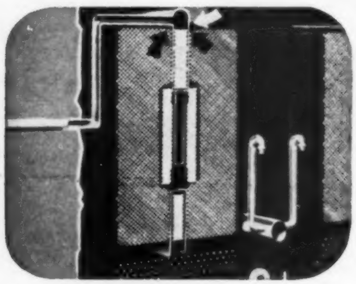


But Wheeler Doesn't limit itself to rectangular design. A round cross section worked out better here, for example, at the first planned gas-steam turbine station ever designed and built in United States.

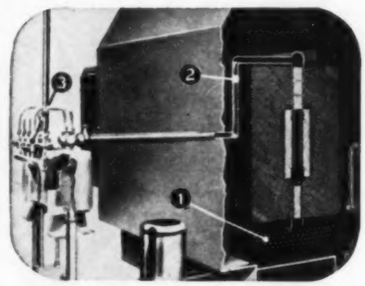
improves power generating efficiencies...



Triple Lane tube layout, another design feature, provides 3 pathways for steam travel, utilizes maximum cooling surface and produces higher condenser vacuums for power generating stations.

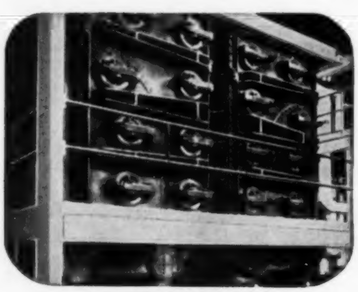


Location of air-vapor takeoff speeds steam travel and allows steam to penetrate to the peripheries of all tubes. It thus improves condenser efficiencies and overall power station operation as well.

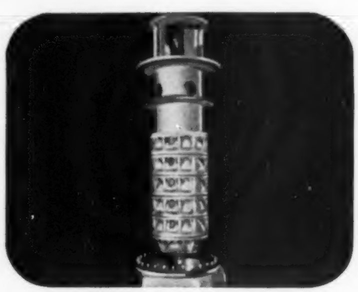


Deaeration of condensate not to exceed 0.01 cc. oxygen/liter is available with special Wheeler designs. Note the Deaerating Bars (1), the Air-Vapor Suction Line (2), and Tubejet® Ejectors (3).

and reduces maintenance



Patented Reverse Flow permits flushing tubes and sheets without shutting down Unit, during full load with either or both circulating pumps operating. No additional circulating water inlet or discharge piping necessary with C.H. Wheeler's Reverse Flow.



"Pull-Out" Condensate Pumps simplify maintenance because entire pumping element, including all rotating parts, can be removed without disturbing either the pump barrel or the piping connections.

C. H. Wheeler Circulating Pumps, like Condensate Pumps, are easy to inspect and maintain because of "Pull-Out" design. In addition, shafts are heat treated alloy steel and impellers are statically and dynamically balanced for trouble-free operation.

C. H. Wheeler has been designing and building condensers since 1903; has developed such features as Dual Bank Design and Reverse Flow.

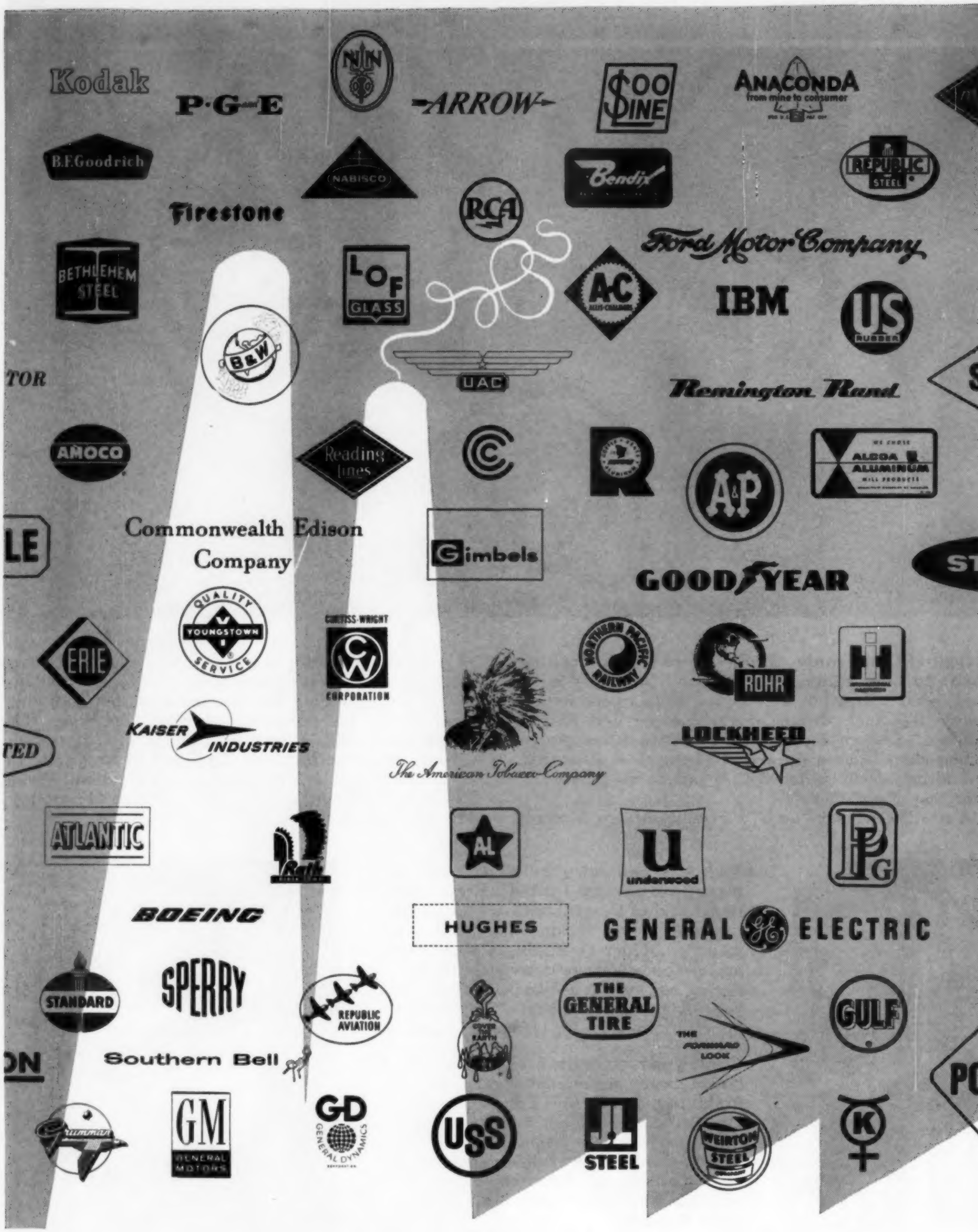
C. H. WHEELER MFG. CO.

19TH & LEHIGH AVENUE
Philadelphia 32, Pennsylvania

Whenever you see the name C. H. Wheeler on a product, you know it's a quality product

Steam Condensers • Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Products


"Mastergauge"
"Quality"
"Standard"



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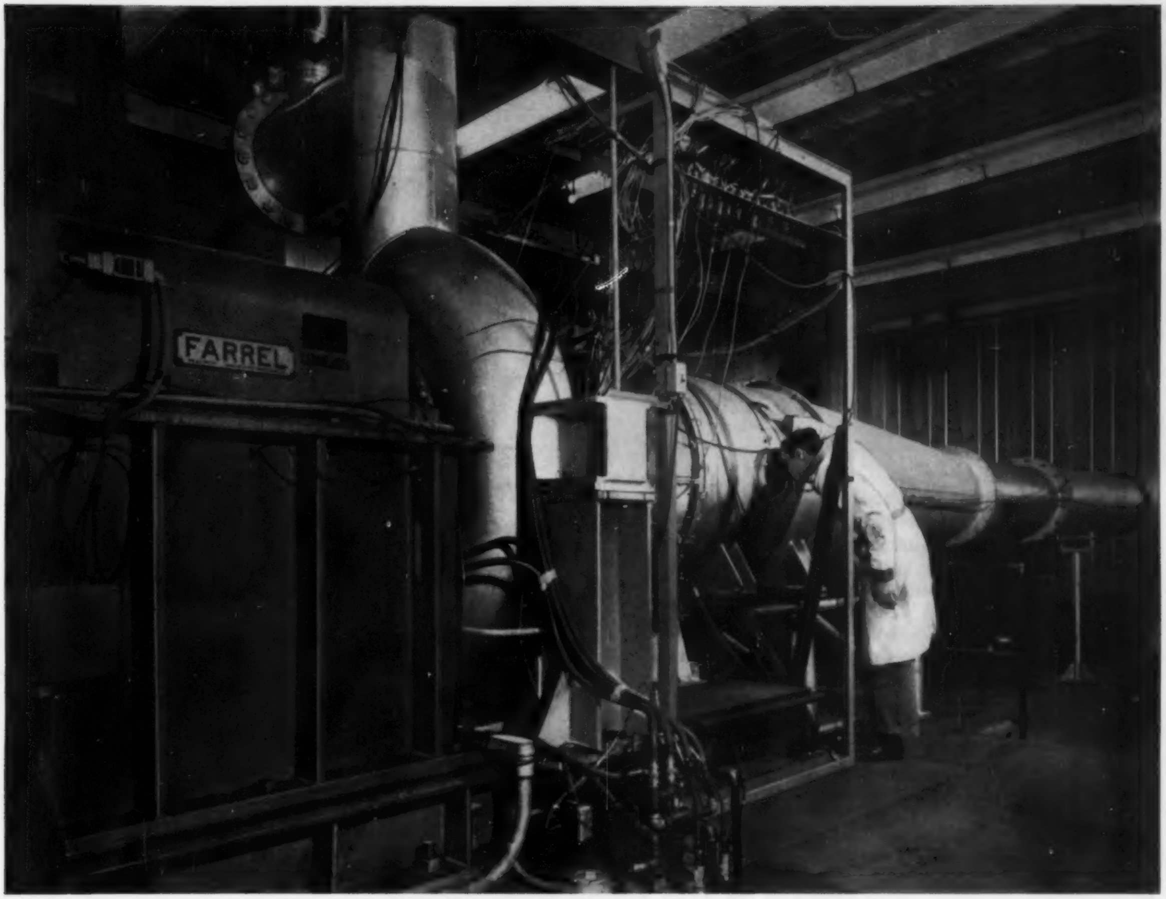
These are but a few of the leading firms which support the Savings Bonds program with more payroll savers than ever before in peacetime.



Special gear unit for Lycoming test stand provides

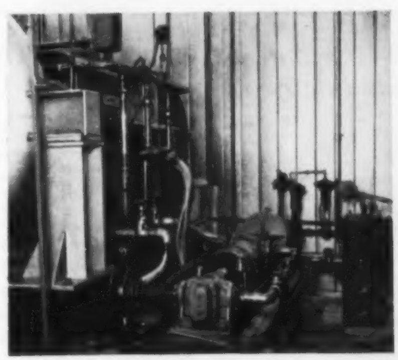
SPEEDS UP TO 27,429 RPM

This high-speed gear unit was specially designed by Farrel for use in a testing program at the Lycoming Division of Avco Manufacturing Corp. It connects a Dynamatic eddy-current coupling, driven by an Allis-Chalmers motor, with Lycoming's gas turbine compressor.

A special feature of the speed increaser is an air-actuated shifting mechanism to change the gear ratio for testing two different size compressors. With a maximum input speed of 1148 RPM from the coupling, output powers and speeds are 5000 HP at 20,111 RPM and 2500 HP at 27,429 RPM.

Other features include a horizontally locked gear train, which provides a more compact arrangement than the conventional design... herringbone gears and pinions, precision-generated by the Farrel-Sykes method... and a pressure lubrication system.

Farrel specializes in the design of gear units to meet unusual conditions of service and has the proven ability to provide the solution to your particular problem. Bulletin 451 will give you further details.



A pressure lubrication system was furnished to lubricate and cool the gears and bearings, while operating within the speed range of the test.

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

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Diaphragm Characteristics, Design and Terminology

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This Manual defines a diaphragm and its performance characteristics, describes methods of measuring and representing them, shows how they are related and used, deals with their construction, describes and illustrates the effects of design details and manufacturing methods on characteristics. In the appendixes, the terms and notation used are defined, the equipment and methods of testing described, applications of the diaphragms are classified and discussed and the various equations derived.

Mechanical Impedance Methods for Mechanical Vibrations

$5.50

Designed to present the state of the art of impedance methods, this book gives precise definitions and shows how impedance methods apply to lumped and continuous systems of simple and moderate complexity, reviews measurement techniques, demonstrates the power of digital computers by comparing the calculated and measured characteristics of a highly symmetrical system of moderate complexity, gives measured values of typical structures of large size and high complexity, discusses the importance of the impedance in influencing shock and vibration spectra measured in field service, shows how to apply impedance methods to the calculation of vibration isolator effectiveness, treats impedance of some disordered systems, and illustrates how impedance methods may be used to find the response to random excitation.

Latest Technology in Oil and Gas Power

$3.00

Here are the papers presented at the 1958 Oil and Gas Power Division Conference, the discussions on them, two 1957 ASME Annual Meeting papers which were sponsored by the Division, and a review of eight papers on internal combustion lubricants originally presented at the 1957 London Conference on Lubrication and Wear.

CONTENTS: Arctic Lubrication of Diesel Engines, Development of a Lightweight, High-Output Four-Cycle Diesel Engine for Naval Service. Lubrication of Large Diesel Cylinders. The Filtration of Diesel Engine Oils. A Method of Charge Stratification for Four-Stroke-Cycle Spark-Ignition Engines. The Contractor's Part in the Development of a Diesel Engine for the U.S. Navy. The Free-Piston-Engine Possibilities. The U.S. Naval Engineering Experiment Station's Part in the Development of a Diesel Engine for the United States Navy. The Bureau of Ship's Part in the Development of a Diesel Engine for the United States Navy. The Buchi-Telescope-Valve System on Four-Cycle Diesel Engines. Scientific Design of a Diesel Governor. Development of a Turbocharged Uniform Two-Cycle, Spark-Ignition Gas Engine. A New Look at Diesel Lubrication. Performance of Economy Diesel Fuels in a Railroad Locomotive-Type Diesel Engine. What Happens to Turbochargers. Maintenance of Fuel Injection Systems. Pressure Fluctuations In Multi-Cylinder Exhaust Manifolds. A Low Temperature Supercharging System for Compression, Pilot Oil and Spark Ignition Engines. Review of Papers on Internal-Combustion Lubricants.

Advances in Materials Handling

$4.50

The thirteen papers in this book were presented at the 1958 Materials Handling Conference, which was sponsored by the ASME Materials Handling Division. The subject coverage ranges from materials handling on the management level to new developments in pneumatic materials handling and in industrial bulk handling, application of advanced materials handling techniques to non-mass production plants, design and development of special equipment such as used for high capacity bulk handling and handling nuclear materials, handling problems with radioactive materials, material handling equipment in missile launching, and materials handling in logistics for missiles.

1957 Report on Oil and Gas Engine Power Cost

$3.00

This Report contains data on 1956 performance and production costs of 438 engines, of which 142 are dual-fuels and 65 gas engines. It has been prepared by practical diesel men of long experience from information supplied by 104 oil and gas engine generating plants, with a total net output of 1,028,689,887 kwhr.

For each plant the Report gives ***details*** on costs of fuel and lubrication, attendance and supervision, maintenance and repair; ***facts*** on type of engine, kind of fuel, installed capacity, type of load—with information on major repairs and the number and duration of enforced shut-downs; the **costs** by years for the plants reporting for two or more successive years; the ***fuel oil economies*** of the three types of engines shown graphically.

Thermal Properties of Gases, Liquids and Solids

$12.50

This book brings together the forty-two papers which were presented at the February 1959 Symposium sponsored by the ASME Heat Transfer Division.

Covering special areas within the broad field of thermal property research, these papers survey the present theoretical and experimental state of the science; indicate the gaps of knowledge existing in both transport and thermodynamic properties, particularly at high temperatures and at high or even moderate pressures; reports a large amount of new data; discuss new and improved experimental and theoretical techniques; review and evaluate the present state of knowledge in the specific areas covered.

Papers are grouped under the following subject classifications: Theoretical Estimation of Transport Properties. Review of Recent Work on Transport Properties. Thermodynamic Properties of Gases and Liquids. PVT Data An Equation of State. Thermodynamic Properties of Boron Compounds. Transport—Properties—Experimental High Temperature Transport Properties of Metals and Ceramics. High Temperature Thermodynamic Properties of Gases.

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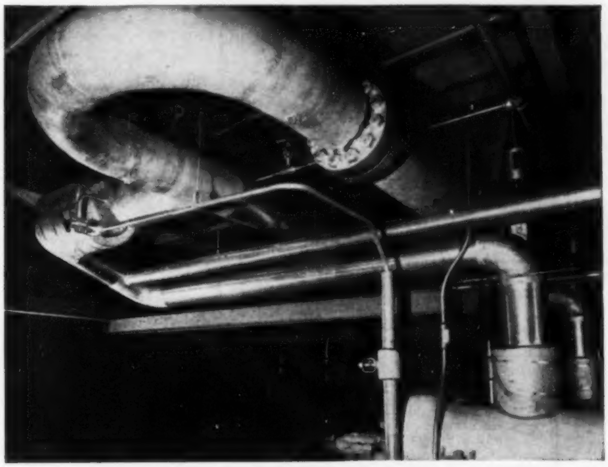
OF SATISFACTION with MIDWEST PIPING

That is the experience of THE HAWAIIAN ELECTRIC COMPANY

Of the eight piping contracts the Hawaiian Electric Company placed with Midwest during the past quarter century, two were for the L. A. Hicks Plant shown above.



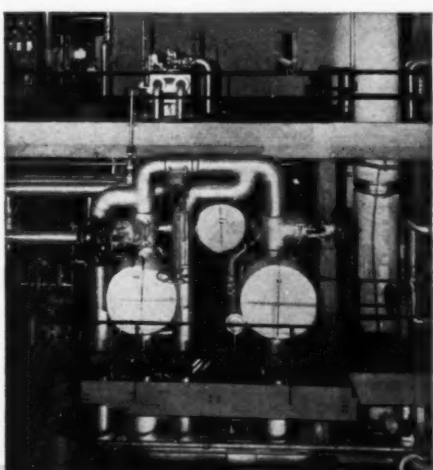
Boiler feed piping fabricated and installed by Midwest for the last unit in the L. A. Hicks Plant in Honolulu.

Benefits that Hawaiian Electric and many other electric utilities get by using Midwest Piping include:

- Unequalled experience of Midwest fabrication and construction organizations.
- Erection planning by staff engineers before fabrication.
- Accurately fabricated subassemblies that simplify and expedite field erection.
- Convenient locations of three fabricating plants.
- Continuous piping research and development.

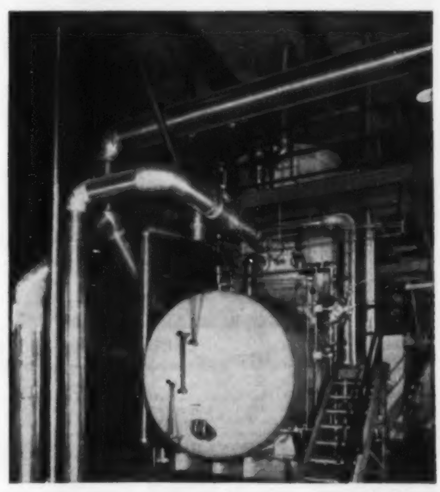
This adds up to a better piping job . . . on time and at minimum cost. It will pay you to call in Midwest the next time you need piping.

8
*** CONTRACTS SINCE 1933**



(Left) Showing Midwest Piping for horizontal and vertical feed water heaters for last two units at L. A. Hicks Plant.

(Right) Main steam and deaerator piping for last unit. Design conditions are 1500 psi and 950°F.



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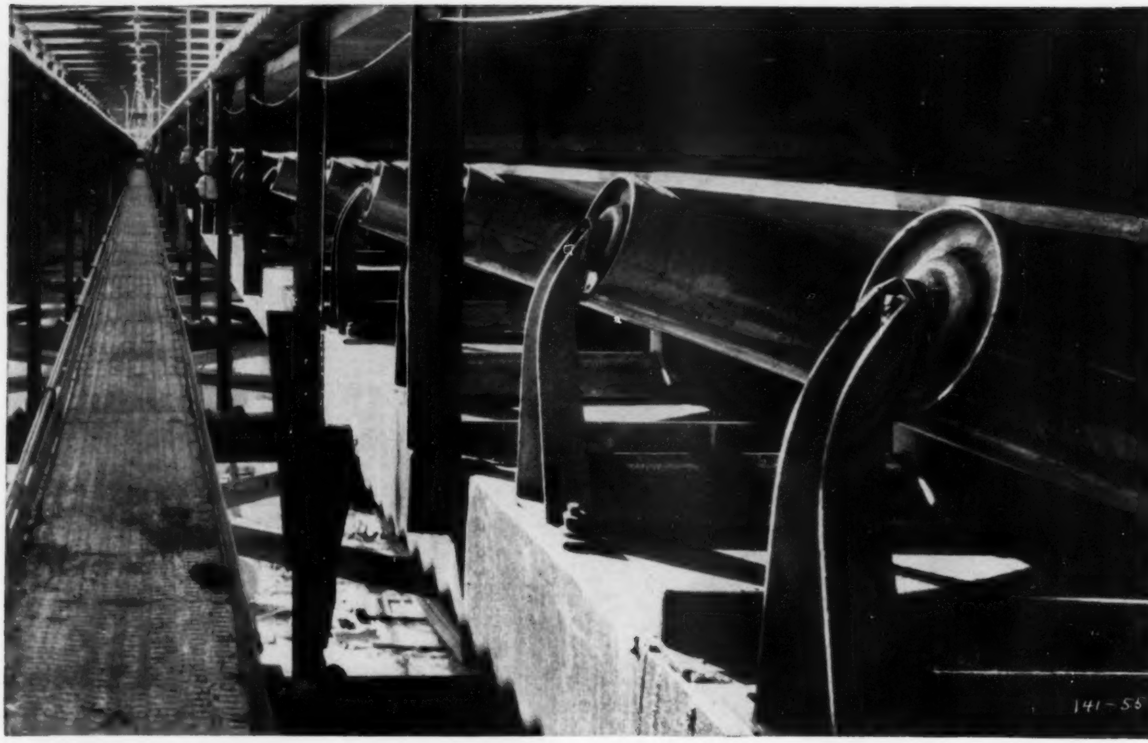
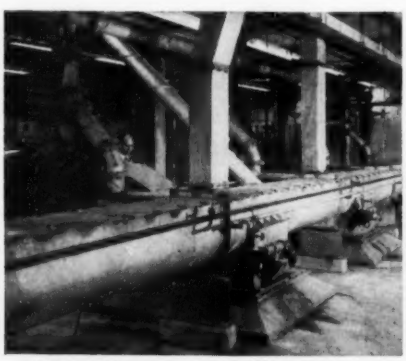


Automate your materials handling...
with **Jeffrey** *equipment*

Efficient, dependable Jeffrey conveying equipment is a valuable antidote for rising costs in processes where bulk materials must be moved. PERMASEAL® idlers on these conveyors mean years of usage without greasing—contribute to lower operating and maintenance costs.

Jeffrey products are available through distributors in principal cities. You'll find these men *production-conscious*, ready and willing to advise on your conveying needs. For this help, see them or write The Jeffrey Manufacturing Company, 915 North Fourth Street, Columbus 16, Ohio.



Jeffrey spiral conveyors are available in many styles for moving dry, bulk materials. Compact, they occupy minimum space. Convenient, they can be fed or discharged at any point along their length.

Components of Jeffrey bucket elevators and other conveyors can be constructed to withstand corrosive attack, assuring long life and safeguarding materials handled.

For in-plant conveying or for belts extending across country, Jeffrey PERMASEAL® idlers offer every feature essential to belt protection, dependability and long service.

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For work on mechanical and economic aspects of processing in nonferrous strip, rod and tube mills. Mechanical or Metallurgical Engineering degree preferred, with some knowledge of industrial engineering. Brass, aluminum or steel mill experience desired. Salary commensurate with experience. Locations in Southern Connecticut and Midwest

Send resume to
MR. F. J. FINSINGER, Personnel Mgr.

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Excellent opportunities in growth industry for high caliber men with degree in MECHANICAL or METALLURGICAL ENGINEERING.

These openings include positions in the following fields:

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Ability to handle complex technical sales relationships of prime importance.

These are permanent openings in a well-established progressive company that has for many years been engaged in the vital Atomic Energy Commission Program.

Qualified men can expect excellent salaries in return for the knowledge, experience and potential they bring us.

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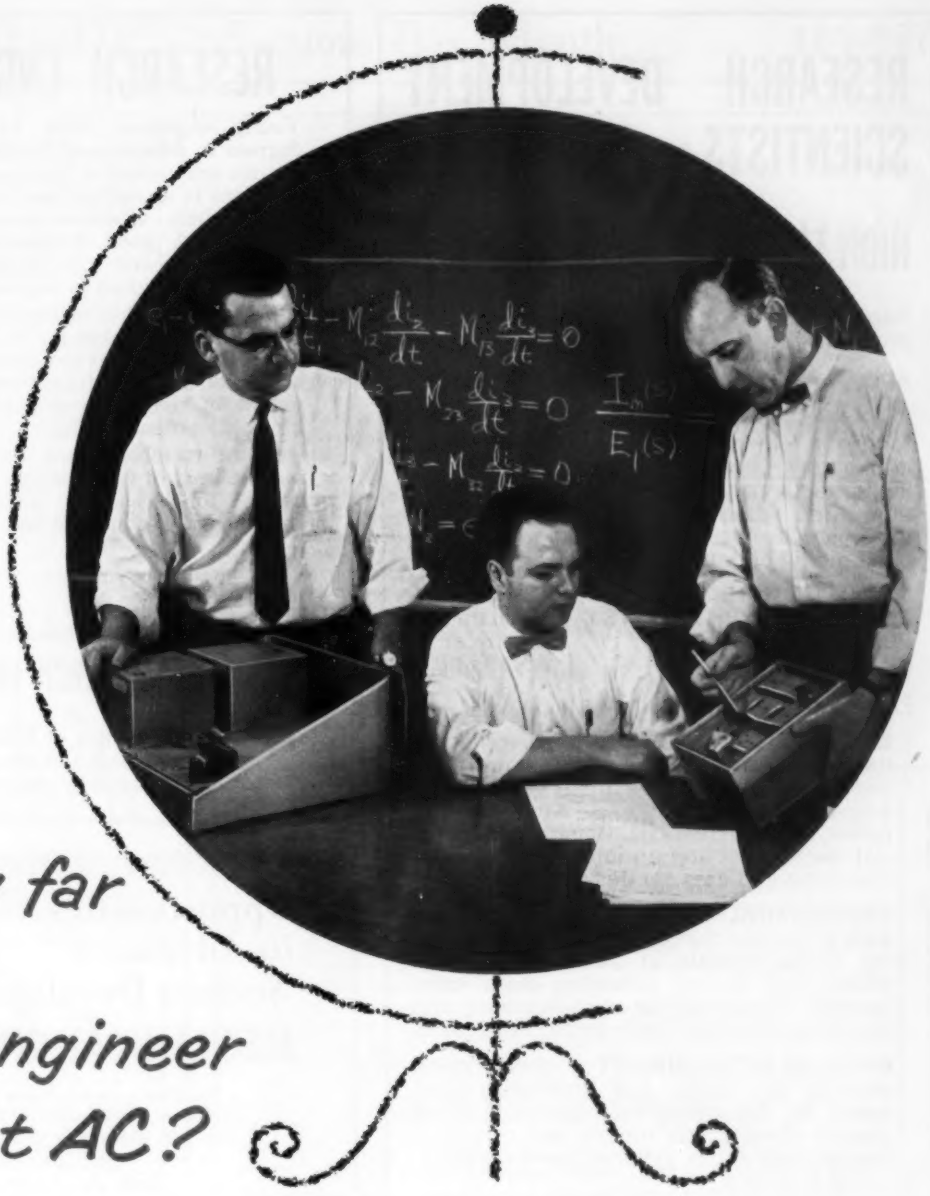

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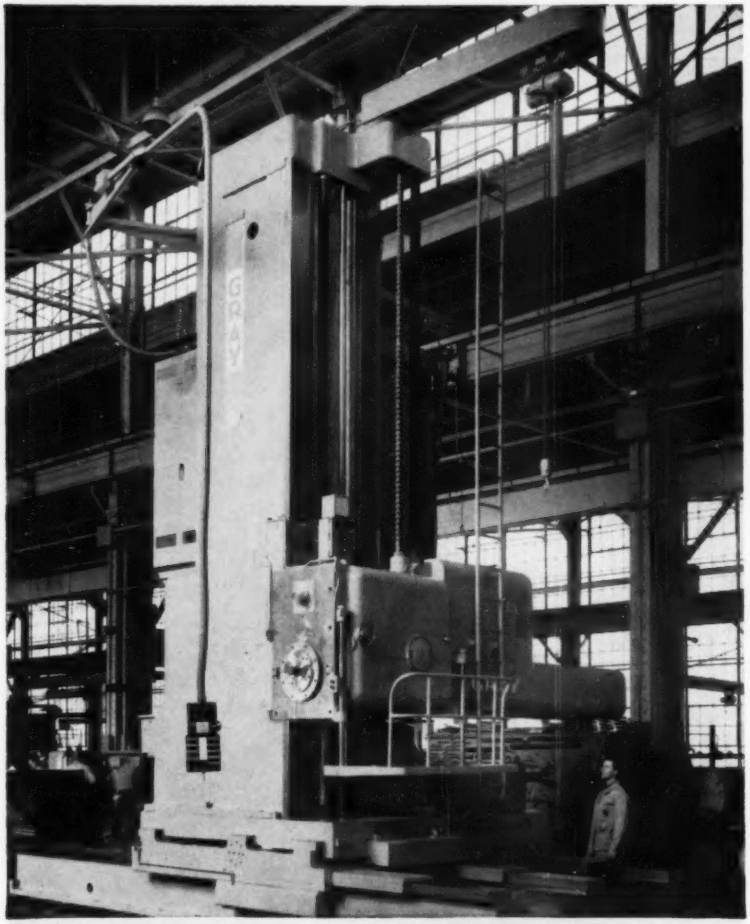

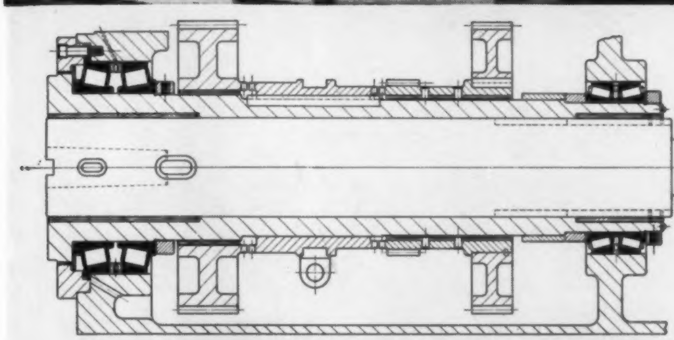

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